THE CURRICULUM DEVELOPMENT PROCESS OF THE NEW ENGINEERING EDUCATION PROGRAM AND ITS PRACTICES IN ETHIOPIA: The Case of Three Higher Engineering Education Institutions

By

Mesfin Sileshi

A Thesis Submitted to the Graduate Studies of Addis Ababa University in fulfillment of the requirements for the Degree of Doctor of Philosophy in Curriculum Design and Development

Addis Ababa University,
Addis Ababa, Ethiopia
January, 2016

THE CURRICULUM DEVELOPMENT PROCESS OF THE NEW ENGINEERING EDUCATION PROGRAM AND ITS PRACTICES IN ETHIOPIA: The Case of Three Higher Engineering Education Institutions

By

Mesfin Sileshi

Advisor
Dawit Mekonnen (PhD)

A Thesis Submitted to the Graduate Studies of Addis Ababa University in fulfillment of the requirements for the Degree of Doctor of Philosophy in Curriculum Design and Development

Addis Ababa University,
Addis Ababa, Ethiopia
January, 2016

Addis Ababa University

College of Education and Behavioral Studies

Department of Curriculum and Teachers' Professional Development Studies

This is to certify that the thesis prepared by Mesfin Sileshi entitled: The Curriculum Development Process of the New Engineering Education Program in Ethiopia: The Case of Three Higher Engineering Education Institutions

and submitted in partial fulfillment of the requirements for the degree of **Doctor of Philosophy in Curriculum Design and Development** complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

Signed by the Examining Board Committee:

Dawit Mekonnen	[signature]	19/01/2016
Supervisor	Signature	Date
ABEBE DINKU	Abebe Dinku	19/1/2016
Internal Examiner	Signature	Date
JM CASE	[signature]	19/1/2016
External Examiner	Signature	Date
Gebregziabher Deses	[signature]	
Chair person	Signature	Date

Dedicated to: Amen Mesfin

Abstract

The overall aim of this dissertation is to contribute to the improvement of the engineering curriculum development and engineering students' learning in Ethiopia by utilizing both theoretical and empirical enquiry. The study tried to provide insights into the major processes and factors that influence engineering curriculum development and its implementation process in general and investigates the impact of the curriculum development and implementation process on the quality of engineering education and students' learning, from the perspectives of stake holders. The study is undertaken within three engineering higher education institutions. The research tried to provide answers for the following four research questions. (1) Why was the engineering curriculum change initiated? And how was it developed? (2) How do deans, teachers and students view and describe engineering curriculum and the congruency between engineering curriculum implementation and curriculum expectations? (3) What are the factors that influenced engineering curriculum development? (4) How do stakeholders assess their involvement in engineering curriculum design process and in its relevance? What are their present understanding of the new engineering graduates in terms of their possession of engineering knowledge, skills and competencies? A qualitative multiple-case study design was employed to undertake the study. Primary data were collected from purposely selected engineering teachers, students, industry personnel, and experts from the MoE using in-depth interview and focus group discussion methods. Document analysis was also used as a source for secondary data. The data collected from the different sources were analyzed using an inductive thematic analysis method based on inductive category development procedure. The findings of the study revealed that the reform in engineering education and its curriculum development was driven by economic interest, which was expressed in terms of producing skilled human resource that would work in industry and boost its productivity. The idea of the reform and the curriculum development process was a top-down process initiated by the ECBP under the leadership of MoCB. Teachers' participation in the curriculum development process was initially one of learning from the ECBP and organizing it in the curriculum; not in decision making. Industry's involvement in engineering curriculum matters was found to be occasional and not in a way it puts significant impact on curricular decisions. Curriculum implementation which involves teaching, learning, and assessment, was knotted with multiple problems of: poor dissemination of the ideas of the reformed curricula, dissatisfied teaching staff and teachers absenteeism, teaching and learning crippled with shortage of resources, shallow students' learning, and pseudo assessment mechanism. Based on the findings of the study, a number of recommendations are forwarded to improve engineering curriculum development and students' learning which include the need for more participation of stakeholders in the process of curriculum development, the necessity of creating more awareness and understanding of the changes in curriculum within the engineering teaching staff, the need for more and continuous training of engineering teachers to update and improve their teaching and assessment skills abreast their engineering profession. The need for the development of educational policies that support the alignment of engineering teaching with assessment, and finally areas for further theoretical research and empirical enquiry are also suggested to support the improvement of the engineering teaching and learning development within the engineering and technology institutions in Ethiopia.

Key words: Engineering curriculum, curriculum development, engineering teaching, qualitative research.

Acknowledgements

I would like to express my gratitude to a number of people who in one way or the other helped me to complete this dissertation work. First, I acknowledge my academic advisor, Dr. Dawit Mekonnen for the unreserved, meticulous comments, suggestions and advice he provided me throughout the progress of this work. I have been very fortunate to have his unyielding support, continuous positive reassurance and his professional guidance. His meticulous and tireless consultations have been pivotal during the whole period of this work.

My thanks also goes to the staff of Addis Ababa University for their unreserved academic and administrative support they have provided me during my course work and during the time of writing this dissertation.

I am also indebted to the engineering deans, teachers and students of Adama Science and Technology University, Addis Ababa Institute of Technology, and Baher Dar Institute of Technology who have participated in this research and provided me their invaluable insights about their experiences in curriculum development and their experiences in the actual practices of teaching and learning at the classroom and/or workshop level.

My gratitude also goes to Dr. Wana Leka and Dr. Jeylan Aman for their reading the material and providing me with feedback that contributed to the work. My thanks also goes to the industry leaders who permitted me to undertake the interview for this research within their respective companies and to the personnel who participated in the interview and provided me the valuable information and insights that contributed significantly to this study.

I am also grateful to my brother, Getahun Sileshi, his wife, Haimanot, and my nephew, Kidist Aklilu and Ato Solomon Shiferaw for the psychological and material support they have provided me during my endeavor of this work. Finally, I am very grateful for my wife, Algayenesh Afework for her devotion and moral support she has provided me during the entire process of this study. I am also grateful to my daughter, Amen Mesfin; her patience and enduring love have been the source of my inspiration in this journey.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

AAiT	Addis Ababa Institute of Technology
AAU	Addis Ababa University
AAUC	Addis Ababa University College
ABET	Accreditation Board for Engineering and Technology
ACQUIN	Accreditation, Certification and Quality Assurance Institute
ASEE	American Society for Engineering Education
ASTU	Adama Science and Technology University
AU	Adama University
B.Sc	Bachelor of Science
BIT	Bahir Dar Institute of Technology
CA	Constructive Alignment
CDIO	Conceive-Design-Implement-Operate
CE	Civil Engineering
DA	Dublin Accord
E.C	Ethiopian Calendar
ECBP	Engineering Capacity Building Program
ECTS	European Credit Transfer System
EE	Electrical Engineering
EEA	Ethiopian Economic Association
EELPA	Ethiopian Electric Power and Light Authority
EiABC	Architecture, Building Construction and City Development
ESDP	Education Sector Development Plans
ETA	Ethiopian Telecommunications Authority
ETP	Ethiopian Education and Training Policy
FDRE	Federal Democratic Republic of Ethiopia
FG 1	Focus Group One
FG 2	Focus Group Two
FG 3	Focus Group Three

FoT	Faculty of Technology
FTI	Further Training Institute
GATS	General Agreement on Trade in Services
GTP	Growth and Transformation Plan
HELENA	Higher Education Leading to Engineering and Scientific Careers
HEP	Higher Education Proclamation
HERQA	Higher Education Relevance and Quality Agency
HESC	Higher Education Strategic Center
HESO	Higher Education System Overhaul
ICDE	Institute of Continuing and Distance Education
Ind.	Industry
IoTs	Institutes of Technology
LCD	Liquid Crystal Display
M.A	Master of Arts
ME	Mechanical Engineering
MI	Ministry of Information
MoCB	Ministry of Capacity Building
MoE	Ministry of Education
MoFED	Ministry of Finance and Economic Development
N	Number (Referring to participants in the study)
n.d	No date
NCTTE	Nazareth College of Technical Teacher Education
NSPE	National Society of Professional Engineers
NTC	Nazareth Technical College
OBE	Outcome Based Education
OCCB	Office for the Coordination of Capacity Building
PSCAP	Public Sector Capacity Building Program
RESR	Report of the Education Sector Review
S&T	Science and Technology
SA	Sydney Accord
SAQA	South African Qualification Authority

SHS	Social and Humanity Sciences
SoA	School of Agriculture
SoB	School of Business
SoE	School of Engineering
SoH	School of Health and Hospital
SoHN	School of Humanities and Natural Sciences,
SoP	School of Pedagogy and Vocational Teacher Education
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISA	University of South Africa
USA	United States of America
WA	Washington Accord

CHAPTER ONE

INTRODUCTION

1.1. Introduction

This chapter includes background of the study, statement of the problem, the research objectives, the research questions, scope of the study, limitations of the study, significance of the study, and the theoretical framework.

1.2. Background of the Study

Education helps in shaping the present as well as the future in terms of developing individuals' knowledge, skill and attitudes, and in the promotion of important and useful ideas within a society. Formal education in any country is hierarchically structured, sequentially ordered and higher education occupies the top position within such educational hierarchy (Varghese, 2008). Higher education, as a part of an education system of any country is entrusted to contribute to the future and to play a vital role in the countries' intellectual, economic, cultural and social development.

Higher education, in general, is believed to be an important means through which students learn and develop democratic values, skills and principles (Dewey, 1929; Essomba, Karatzia-Stavlioti, Maitles and Zalieskiene, 2008). The university, as an institution is also regarded as an "agent" and "servant" of democracy (Huber & Harkavy, 2007: 42). According to Huber & Harkavy, the university is an agent because it's continuing activities nurture "deliberation" and the democratic spirit. It is the servant because its members- faculty, staff, students, and alumni dedicate their professional skills to serve the wider common goal. The university is also understood as a "democratic public sphere" (Giroux, 2015: 110) in which education enables students to develop a keen sense of prophetic justice, claim their moral and political agency, utilize critical analytical skills, and an ethical sensibility through which they learn to respect the rights of others.

Higher educated citizens are more likely to understand democracy in terms of free elections, civil rights, gender equality, and economic prosperity (Chzhen, 2013).

In recent years, higher education is emphasized to be one of the powerful forces for individual growth, societal progress and cultural and economical development (Bloom, Canning, & Chan, 2005; MoE, 2010). Higher education is seen more than ever, as a focal point for the socio-economic and political development of nations (UNESO, 1998; Schwab, 2010, World Bank, 2007; Santiago, et.al., 2008).

In another sense, higher education is also regarded as one of "the 12 pillars of competitiveness" (Schwab, 2010: 4) that drive productivity. Schwab states that quality higher education and training is crucial for economies that want to move up the value chain beyond simple production processes and products. As pointed out in UNESCO (1998a: 1):

> *Without adequate higher education and research institutions providing a critical mass of skilled and educated people, no country can ensure genuine endogenous and sustainable development and, in particular, developing countries and least developed countries cannot reduce the gap separating them from the industrially developed ones. Sharing knowledge, international co-operation and new technologies can offer new opportunities to reduce this gap* (1998a: 1).

This quotation, in the first place, informs us that higher education and research institutions are significantly important for sustainable development. In the second place, it tells us that genuine and endogenous development would be difficult without cooperation and sharing of knowledge. In the third place, it also informs us that technology is one of the indispensables in the endeavors of development. A similar idea was also promoted by the World Bank (2000). The findings of the Commission on Science and Technology for Development (CSTD) as reported by the secretary general (2006), also pointed out that "most developing countries are unlikely to narrow the technology gap without making Science and Technology top priorities in their development agenda" (CSTD, 2006: 17).

Research has also suggested that there is a strong association between higher education participation rates and levels of development, and that high levels of education are essential for the design and production of new technologies, for a country's innovative capacity and for the development of civil society (Cloete, Bailey & Maassen, 2011). Hence, society holds high expectations of people in professions entrusted with the well-being of people and society as a whole (Davis & Davis, 2005). Higher education institutions, in general, are required to educate and train personalities who would be able not only to think individually and creatively but also to successfully act and compete individually or in groups in both national and foreign labor market. Hence, education reformers in the late 1980s and in the 1990s argued that society needed and called for a workforce which is flexible, highly qualified, independent and entrepreneurial work (Bleiklie, 2004).

Curriculum in higher education is understood as one of the key concepts by which the idea of higher education is put into practice (Barnett, 2009; Barnett & Coate, 2005: 5). At college level, curriculum is regarded as an "academic plan" that implies a deliberate planning process that focuses attention on important educational considerations (Lattuca & Stark, 2009: 4) which will vary by field of study, instructors, students, and institutional goals. Curriculum informs what the purpose of education should be, what to include in this education, how and when to do it and how to check the effectiveness and think of further improvement in the whole process of education. Any curriculum development process strives for answering the question of how a curriculum is planned, implemented and evaluated, as well as what people, processes and procedures are involved (Ornstein and Hunkins, 2009: 15; McKernan 2008: 4).

UNESCO indicates that "most of the broader history of civilization, of economic and social relations, is the history of engineering, engineering applications and innovation" (UNESCO, 2010: 30). According to UNESCO, the Stone Age, Bronze Age, Iron Age, Steam Age and Information Age all relate to engineering and innovation that shaped human beings' interaction with the world. In addition to its developmental roles, the engineering profession at the present time is also expected to address the large-scale pressing challenges facing societies worldwide. Gordon (1984) defines a professional engineer as "one who has attained and continuously enhances technical, communications, and human relations knowledge, skills, and attitudes, and who contributes effectively to society by theorizing, conceiving, developing, and producing reliable structures and machines of practical and economic value" (Gordon, 1984): in Crawley, et al. 2007: 11). Concern about engineering education, at undergraduate level and the curriculum development process and its practices then refers to laying down the ground for the preparation of the underlying requirements which means for developing and equipping individual learners to be able to know, understand and act effectively in engineering thinking, design and the production of improved artifacts and modern services through the use of science and mathematics to make the human life easier and comfortable. Engineering education as part of higher education and the curriculum development process associated with it and its practices at different levels occupy one of the central positions as a means of fulfilling of such expectations (Maraghy, 2011: 11, UNESCO Expert Group, 1995:1).

Engineering education is one of the central elements used to produce human resources for the social and economic development of any society (Bloom, Canning, and Chan 2006; UNESCO, 2010). Engineering education programs provide students with the knowledge, understanding, skills and competences required to be professional engineers. These include scientific and mathematical theory, engineering applications, design, problem-solving skills, and communication skills. The National Society of Professional Engineers (NSPE) (2013) refers to the knowledge, skills, and attitudes of engineers as "capabilities", where capability is defined as "what an individual is expected to know and be able to do by the time of entry into professional practice in a responsible role (NSPE, 2013:4). As pointed out by Duderstad (2008), the requirements of 21st-century engineering are considerable: engineers must be technically competent, globally sophisticated, culturally aware, innovative and entrepreneurial, and nimble, flexible, and mobile. In another tone, Rugarcia, Felder, Woods, and Stice (2000) also sketch engineers' profile in terms of three components, that is, in terms of:

> *(1) their knowledge—the facts they know and concepts they understand; (2) the skills they use in managing and applying their knowledge, such as computation, experimentation, analysis, synthesis/design, evaluation, communication, leadership, and teamwork; (3) the attitudes that dictate the goals toward which their skills and knowledge will be directed—personal values, concerns, preferences and biases. Knowledge is the data base of a professional engineer; skills are the tools used to manipulate the knowledge in order to meet a goal dictated or strongly influenced by the attitudes* (Rugarcia, et al, 2000: 20).

Some of the challenges to be addressed by engineering, among many others, include availing access to affordable health care, tackling the issues of energy, transportation, and climate change, providing equitable access to information, clean drinking water, natural and man-made disaster mitigation, environmental protection and natural resource management (UNESCO, 2010). To this end Maraghy (2011) states that "engineers play a key role in our societal development, contributing to and enabling initiatives that drive economic progress, enhance social and physical infrastructures, and inspire the changes that improve our quality of life" (Maraghy, 2011: 11). Moreover, Morrow asserts that engineering education as "the quintessential education required for nations to prosper in this technologically interdependent world in which we live" (Morrow, 1994: 15).

While engineering education and its importance is a widely recognized part of education that contributes to the overall development of individuals and society, it is pointed out that it is also caught up 'between seemingly irreconcilable tensions of two positions' (Crawley, Malmqvist, Ostlund & Brodeur, 2007: 10). According to Crawley et al., the tensions include: on one hand, the need to convey the ever-increasing body of technical knowledge that graduating engineers should master and on the other hand, the growing acknowledgement that engineers must possess a wide array of personal and interpersonal skills as well as the product, process and system building knowledge and skills required to function on real engineering teams to produce real products and systems (Crawley, et al. 2007: 10). These authors make clear that engineering educators "strike a balance that emphasizes the importance of technical knowledge" and on the other hand, industry representatives are concerned about the need for a broader view that give "greater emphasis to the personal and interpersonal skills, and product, process, and system building skills" (Crawley, et al. 2007: 10).

Research shows that engineering curriculum in the US before the 1940s at most colleges and universities was mostly practical with the emphasis on engineering design rather than on engineering sciences and mathematical applications (Lattuca, Terenzini, Volkwein, and Peterson, 2006; Splitt, 2003). Tryggvason and Apelian (2006) also indicate the past engineering education as it was focused on "hands-on training". However, after World

War II, the field of engineering and the undergraduate programs changed dramatically and the “launching of Sputnik in 1957 accelerated this shift, and by the early 1960s most of the old hands-on courses had been replaced by lectures” (Brent & Felder, 2003: 234).

Courses in advanced mathematics and theory replaced practical courses in machining, surveying, and drawing (Prados et al., 2005). But by the 1980s, such education left engineering employers to be dissatisfied (Lattuca et al., 2006; Gordon, 1984; Ambrose, 2013). Graduates from such programs were technically well prepared but lacked the professional skills for success in a competitive, innovative, global marketplace (Lattuca, et al. 2006). Employers complained saying that graduates of the programs had poor communication and teamwork skills and did not appreciate the social and nontechnical influences on engineering solutions and quality processes (McMasters, 2004; Todd et al., 1993). Then, a call for change and improvement of engineering education was signaled through several national reports within the USA (Lattuca et al, 2006) which eventually paved the way to the emergence of an accreditation set of criteria known as “Engineering Criteria 2000”. Such change in engineering education, however, requires the deliberation and use of curriculum which is designed, developed and implemented in accordance with the best of its peculiar nature and characteristics. In connection with this, nations all over the world, including the developed nations such as USA and many countries in Europe and elsewhere continually reexamine and re-energize their engineering curricula (Heywood, 2005; ASEE, 2010; Nguyen, 1998; HELENA, 2009; Felder, 2004). Haywood (2005:4) indicates that “understanding of the curriculum process requires an understanding of institutional structures, practices and procedures”.

A significant example of an engineering curriculum development model which is developed on the basis of the analysis of the issues and tensions prevalent in engineering education and with the consideration of the desired attributes of engineers is known as Conceive-Design-Implement and Operate (CDIO) (Crawley, et al., 2007). The CDIO program, as pointed out by Crawley and others, was developed based on critical need to educate students who are able to Conceive-Design-Implement-Operate complex, value-added engineering products, processes and systems in a modern, team–based environment (Crawley et al. 2007: 1). More or less similar actions were also taken in

Europe. The CDIO model was also recognized and implemented in some of European universities such as that of the University of Liverpool, (Kearney, 2011).

In Ethiopia, a system wide education reform in the wider public was heralded with the issuance of the Education and Training Policy in 1994 by the Federal Democratic Republic Government of Ethiopia (FDRE). In this document education in general is envisioned as bringing-up citizens endowed with human outlook, countrywide responsibility and democratic values having developed the necessary productive, creative and appreciative capacity in order to participate fruitfully in development and the utilization of resources and the environment at large (FDRE: 6). The document also pointed out that problems associated with relevance, quality, accessibility and equity need to be addressed and education should be future oriented. Moreover, it is also stressed that the aim of education has to do much with the idea of strengthening the "individuals' and society's problem-solving capacity, ability and culture all the way through basic education and at all levels" (FDRE, 1994: 1).

These being the essence upon which the present Ethiopian education policy in general rests, included in it were suggestions about the emphasis to be put on all levels of higher education and the type of graduates expected from higher education (FDRE, 1994: 15). It also suggested about the mechanism of implementing the curriculum in higher education and the qualification of teachers who would teach at that level (FDRE, 1994: 21). According to the same document, institutions are provided with autonomy of internal administration in designing and implementing education and training programs with an overall coordination and democratic leadership by boards or committees, consisting of members from the community (society), development and research institutions, teachers and students (FDRE, 1994: 30). It also pointed out how the curriculum should be prepared, implemented, and evaluated and that it has to be based on the stated education objectives. It has also outlined that the process of curriculum development: has to involve all the beneficiaries including professionals from major organization of development, has to be considerate of pedagogical and psychological methods and has to be up to international standard and there will be an integrated educational research, and overall periodic evaluation of the education system.

The issuance and implementation of the 1994 Education policy, undoubtedly resulted in a number of positive changes such as availing education for more people, the increase of educational institutions, provision of education in local language and the development of curricula in different language, and more, within relatively short time (MoFED, 2006:7-9).

A specific and more attention was given to higher education with the issuance of the Higher Education Proclamation (HEP) (Proclamation No. 351/2003) (FDRE, 2003)[1], by the government. This legal document emphasized the necessity of laying down the requirements that would enable the higher education system to produce quality skilled human power to meet the needs of the country, the necessity of directing research in higher education towards problem-solving and towards the utilization of potential resources, the necessity of the provision of academic freedom and accountability of higher education institutions and the administration within them and the necessity of determining the directions of private higher education institutions in order to promote their contribution in expanding education and conducting research. The objectives of higher education, as stated in this legal document included the following:

- *Produce skilled manpower in quantity and quality that will serve the country in different professions;*
- *Provide equitable distribution of higher education institutions;*
- *Lay down problem-solving educational and institutional system that enables to utilize potential resources of the country and undertake study and research;*
- *Provide higher education and social services that are compatible with the needs and development of the country.* (HEP, No. 351/2003: Article 6).

Within the same document it was also suggested that the curriculum in higher education has to focus on practical experience and student participation and that implementation should be practice-oriented; that it should take the objective situation of the country into consideration, encourage independent thinking, and reflect modern views, and that it has to be problem-solving. It also included suggestions about assessment of students (Article

32). As per this article, any institution should have an assessment mechanism to evaluate the ability and level of knowledge of the student and that assessment shall be based on the content of course or training offered to the student, and that the method of evaluation shall be determined by the institution.

However, after ten years of the issuance of the education policy and after one year enforcement of the Higher Education Proclamation (Proclamation 351/2003), the report of the Higher Education System Overhaul (HESO, 2004) declared that higher education institutions lacked a culture that puts stakeholders at the center of the quality process, that students did not have rights with respect to fair and open systems for establishing standards, that employer feedback is not collected systematically, and there is too little attention to the quality of educational outcomes.

Based on what it thought to be drawbacks and pitfalls of such as those mentioned herein above, the HESO report concluded that "Ethiopia does not yet have an elite university, i.e., a university that neither meets international standards nor do HEIs meet the development needs of the country in terms of relevance" (HESO, 2004). Nevertheless, the HESO committee recommended (among many other recommendations) an improved governance, leadership, and management that would contribute to desirable social outcomes of more graduates at every level, a better match of graduate knowledge and ability to Ethiopia's development needs, research and consultancy more relevant to the needs of the community, teaching, learning, research and consultancy that reach (or approach) international standards, responsible citizens and more equal society, and higher education instructors that support democracy and the constitution (HESO, 2004). The HESO inquiry focused more on the governance, leadership and matters associated with it. However, It "did not invest much in curriculum revision and/or development practices nor did it include specific reforms needed to overhaul the academic programs" (Solomon, 2010: 95).

---

[1] This document is replaced later, in the year 2009, by Higher Education Proclamation No. 650/2009.

In September 2009 the six year old Higher Education Proclamation No. 351/2003 was substituted with a new Higher Education Proclamation No. 650/2009 which served as a foundation for the reform of the higher education system. In this proclamation more emphasis was placed on the necessity of institutional transformation, the necessity of focusing on issues of relevance and equity of education and research, including ensuring good governance and others. Effecting institutional transformation and enabling the institutions to be dynamic centers of capacity building were also emphasized. In most respects the objectives stated in this proclamation are the same as those of the objectives, stated in proclamation 351/2003, but in proclamation 650/2009 additional emphasis was given on institutional expansion and access on the basis of need and equity. In addition to this, the Government's Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06-2009/10) which was issued in 2006 considered higher education as a significant means of meeting the need for highly trained work force.

Engineering education, which is part of higher education in the Ethiopian context, is provided within government and non-government universities, institutes, and colleges. There is no accrediting body specifically meant for engineering education in the Ethiopian context. The only external accrediting body concerned with matters related to higher education quality so far is the Higher Education Relevance and Quality Agency (HERQA). Even though, in principle, certain autonomy is delegated to the various government and educational institutions within the education system, the overall practice of education has to be consistent with the government's education policy and has to be guided by it, and this applies to engineering education as well in many respects. Anything that affects the whole system of higher education also affects the engineering education.

A more specific reform initiative geared to engineering education was the move taken by the Engineering Capacity Building Program (ECBP), which was launched in the year 2005 under the leadership of the Ministry of Capacity Building (MoCB) (Waidmaier-Pfister, et.al, 2008) and with financial and technical cooperation of Germany (Ethio-German, Negotiation, 2005) through the regulation of ECBP, carrying the motto "Building Ethiopia".

The government's agenda in launching the Engineering Capacity Building Program can be seen as part of the Public Sector Capacity Building Program (PSCAP) (FDRE, Proclamation No. 256/2001) and as part of the overall reform of higher education and training and capacity building that was aimed "at creating country wide sustainable human resource capacity that is responsive to changing circumstances" (MoE, 2002: 3). However, the reform in engineering education was more of responding to the need of industry which was fueled by the government's idea of "accelerating industrial development in Ethiopia" (Knoop, n.d). The main aim was to support the private sectors through supporting the institutions that support them, among which the university program was taken as one, (in fact, as pillar No. IV of the ECBP). The university reform component of ECBP was then intended to support the transformation of higher education, which in this case means engineering education, to deliver most needed human capital for the labor market. The objectives with regard to this were stated as the following:

- *Development and governance of efficient institutes that work at the intersection between higher education and economy*
- *Implementation of engineering study programs based on international standards;*
- *Integration of technology transfer approach to provide solutions to industry. (Knoop, n. d.)*

Generally, it is believed that higher education institutions are 'slow to change' and 'change is often forced on them from outside' (Haywood, 2005: 4). This seems true in the case of the Ethiopian engineering education. Unlike the usual practices of the curriculum development process in higher education in Ethiopia, and irrespective of the provisions stipulated in the policy documents, a curriculum framework was developed under the leadership and guidance of the ECBP, which received the support of German/Swiss experts. Based on that framework and supported by the aforementioned experts 'numerous new engineering courses' and 'occupational standards' were developed (Federal Ministry for Economic Cooperation and Development, 2008).

Even though there are a number of higher education institutions concerned with the provision of engineering education within the country, the Faculty of Technology of Addis Ababa University was regarded as the "change model" (Wondwossen, 2006) and was given priority to revise the then existing engineering curricula under close leadership and support of the ECBP together with those professors from Germany and from some other countries. As pointed out by the group of the German/Swiss experts who participated in the engineering curriculum development process, the general aims of the revised curricula were:

- *Orientation towards the expected qualification of the students at the end of their study time.*
- *Introduction of new teaching learning methods, especially interdisciplinary project work.*
- *Defining closer links between practice and theory as a continuous of needs and ideas between the academic and professional spheres. The curricula include different elements of practical training and internship in order to bridge the gap between industry and academia.*
- *The new curricula focus on specific Ethiopian issues in teaching and research which are significant for the future and sustainable development of the country.*
- *The curricula are based on a close, interdisciplinary cooperation between the respective departments. Exchange programs with national and international universities and institutions will be intensified.*
- *Providing effective tools for permanent sustainable quality assurance of study programs and didactic quality*
- *Restructuring of the Faculty of Technology;* (Bayou, Tenagne, Bühler, and Oswald, 2006: 7).

After the curriculum development process was over at the faculty level and as soon as the preliminary peer review process was undertaken by a peer group of the Accreditation, Certification and Quality Assurance Institute (ACQUIN) in Germany, implementation (at least in pilot form) was began in the academic year 2006/2007 in government engineering faculties/institutes notably at the Faculty of Technology of Addis Ababa University (now divided in to two institutes of technology-AAiT and EiABC). Implementation of curricula also continued in other similar engineering institutions and universities, such as those selected for this study, in subsequent years.

1.3. Statement of the Problem

It has been mentioned earlier in this chapter that echoes of change in the Ethiopian education system were signaled more than ever since 1994 with the issuance of the education policy and the subsequent education proclamations and guidelines provided by the Ethiopian government. The ideas of change, on one hand was to lay the ground that addresses problems of various natures such as those related to quality of education (Bayou, et al. 2006) and to alleviate the shortage of skilled and semi-skilled human labor (EEA, 2008) within the prevailing system, on the other hand it was an attempt of widening the scope of the system to accommodate new opportunities and ideas and at the same time to reach to the wider populace within the nation. The former of these ideas can be seen as an idea of improving and transforming the existing system and to give it better shape and form for better use. On the other hand, the latter calls for creating a totally new ground for practice that requires the preparation and availing of both physical and human resources that can be used for materializing the new ides. While the former idea is to improve the existing system by changing some of its aspects, the later demands a fresh idea and practice of introducing new educational elements which require availing new infrastructure like school buildings, new equipments, and knowledgeable human resources for its implementation.

So, the current Ethiopia as a nation, in its attempt of changing the education system, is caught up between those contesting challenges of improving the existing system and expanding the system with the intention of addressing new challenges and problems. The problem in this research then arises from this context. As far as this researcher is concerned there is no evidence of publically known and a comprehensively documented reform attempt in the wider context of engineering education in Ethiopia until the launching of the Engineering Capacity Building Program (ECBP) in 2005 which adopted a guiding motto of "Building Ethiopia" in its reform effort (Bayou, Tenagne, and Bühler, 2006). Nevertheless, the few available sources reveal that there were some changes associated with the durations allotted for the provision of engineering programs within the educational institutions and these were made usually in connection with the regime changes of the country (Demiss, Alem, Daniel, and Edessa, 2006). Furthermore, one of the scanty available materials also points out that:

> *The education in the FoT was not sufficiently practice oriented, graduates were not problem solvers, its administration and governance system is plagued with undue centralization, insufficiency and lack of transparency. Furthermore, the Faculty's weak link to the industry has led to inability to make curriculum and research relevant to the needs of the country and, therefore, has resulted in its limited contribution to the national economy* (RSC, 2007: 6).

The Ethiopian government, fueled with an ambitious program of accelerating industrial development through supporting the engineering program, launched the reform in engineering education in 2005 under the leadership of the MoCB through a specific program identified as Engineering Capacity Building Program (ECBP) in cooperation with Germany (Ethio-German Negotiations, 2005). The ECBP by then has four components, of which, one is the university reform component that was particularly geared to the reforming of engineering education. The ECBP was based on the guiding principles of "private sector, market and demand orientation, improved qualifications of human resources, entrepreneurship development and public-private-Dialogue (PPP) to make individuals and enterprises competitive in the international market" (Bayou et al (2006: 15) and its objectives include the:

- *Development and governance of efficient institutes that work at the intersection between higher education and economy*
- *Implementation of engineering study programs based on international standards;*
- *Integration of technology transfer approach to provide solutions to industry.*

Based on these principles, through the support and guidance of the ECBP, a number of curricula were developed and implemented since 2006/2007 Academic Year within different engineering education institutions. Moreover, the Ethiopian Government has placed high emphasis on the provision of science and engineering education (MoE, 2008) to those students who qualify and join higher education. As per this priority, 70% of those who qualify for entrance to higher education are streamed to science and engineering education. While 40% of these are further assigned to the different fields of engineering education, the rest 60% are dispersed across the natural sciences, mathematics and other educational streams.

According to the Government's Growth and Transformation Plan I. by 2014/15 the total number of students who join higher education at the undergraduate level will be 467445 (MoFED, 2010a: 20). Out of these, about 327211 of them will be placed in science and engineering education from which 40% are again streamed to engineering education. This, according to the provision in the "Annual Intake and Enrollment Growths and Professional and Program Mix of Ethiopian Public Higher Education" (2008), means that by the year 2014/15, the number of students who will be admitted to engineering education will be 130884. This number is about 28% or more than one quarter of the total number of students (467445) who join higher education.

Generally seen, the objective of the ECBP was to improve the framework for economic and private sector development through demand-oriented engineering, technical and vocational education reform, and quality infrastructure upgrading and business improvement throughout the country. It is now about seven years since the implementation of the reformed curricula took place in the Ethiopian engineering education institutions. Many engineering students have already graduated using the reformed curricula and many others are in the pipe line. A number of graduate engineers have already started joining the world of work within the country. This implies that the reformed system generally has started to give the desired results, at least in terms of the number of engineers that are needed in the country. The key question is, however, is it only the increase in the number of engineers that matters to the country? If not, what else should be considered? Obviously, the answer to the last question points towards the quality of engineers in terms of their knowledge, skill, attitude and what they can do in the real world of work upon their graduation. This is why the current study intended to look into the process of the curriculum development and the actual practices that are taking place on the ground, where the interface between the ideas of the curriculum and the people who put it into effect and between the people who are affected by it taking place, within the identified three institutions from the perspective of the stakeholders.

Although studies of curriculum and curriculum development process in engineering education are very much limited in the Ethiopian context, experiences of the curriculum development process in general, and its practices at all levels of education in Ethiopia have never been without criticisms all the way through the history of the Ethiopian modern education system. Problems associated with curriculum and curriculum development are rooted in many ways in the Ethiopian education system at each level of education, irrespective of the fields of studies and/or the subjects to be taught/learned and the skills, competencies, attitudes to be developed. Discontents of such type were reflected in the works of many writers and researchers who have dealt with issues related to curriculum development and its practices at various levels along the continuum of the education system in Ethiopia since the 1950s. For example, MoE (1950) has stipulated that there was lack of uniformity of subject matter taught in equivalent grades or levels of instruction. MoE, (2002) has also identified and summarized the problems and the various challenges pertaining to the education system at all levels. Shibabaw (2002) indicated that teachers lack curriculum knowledge, Temechegn (2000) on his part has pointed out that there are varying problems associated with science education, furthermore, (Amare 1998 and Woube 2004) have identified that there is lack of cultural considerations in curriculum development. More recently, Mulu (2009) mentioned that the curriculum in higher education follows traditional methods and focuses on theory and lacking the practical side. His findings have also revealed that the teaching learning method is teacher-focused rather than student centered, Ayalew, Dawit, Tesfaye and Yalew (2009) pointed that staff in Hawassa and Baher Dar Universities do not meet the minimum standards set by the Ministry of Education, that the university entrants are not prepared for higher education, that the contents of the curricula do not match the graduate profile indicated in the programs, and that learning resources do not adequately match the size of enrollments in the respective areas of studies and where the materials and equipment are available in some quantity, there are not enough technically qualified personnel to maintain, repair and properly use them, Solomon (2010) revealed that the environment in most public universities is “messy and the quality of teaching and learning are at risk” and he pointed out that excessive government intervention and lack of autonomy are the prime factors contributing to this risk.

In fact, the problems addressed in those studies appear to have existed within the other levels of education as well and most of them do not rest particularly within the scope of this study, yet, their implication to engineering education is evident since engineering students are the products of the curriculum and its practices at those levels. The problems can be characterized as multi-dimensional and interrelated to each other. Yet, the specific nature and depth of the problems in curriculum development and practices at all levels specifically at the level of higher education including engineering education, are not well known and are less researched in the context of the Ethiopian education system. Curriculum development is an iterative process that swings between the intent of education system and its actual practices. This means that the study of curriculum, without giving due consideration to the actual practices on the ground, remains to be the study of a document (curriculum document) which is devoid of the process of teaching and learning and the people involved in the process. The scarcity or the unavailability of research on curriculum development process and its practices in comprehensive form, almost at all levels of the education system that includes higher education including engineering education may obscure the reality with which the engineering curriculum is functioning on the ground. Such a situation does not lend itself to making advancement on what is good and to making corrections on what sounds unclear and irrelevant in terms of both epistemological perceptions and practical aspects. Hence, the researcher claims that the nearly non-existence of research similar to this in engineering education in general, and in engineering curriculum development and its practices in particular, in the Ethiopian context, together with the points made herein below, makes this study the first of its kind and, hence, essential, in terms of its contributions both epistemologically and practically. Moreover, the strengths and weaknesses of the engineering curriculum development process that has been implemented since the year 2006/2007 Academic Year has not yet been comprehensively researched and evaluated, at least to the knowledge of this researcher. Thus, it is hoped that this research, to some extent, also contributes to identifying the strengths and the challenges of the engineering curriculum development process and its practices within the context of the Ethiopian education system.

1.4. The Research Objectives

The research has the following objectives:

- To understand the core ideas that informed/guided the reformed engineering curriculum development process and to analyze them from the perspectives of the participants;
- To find out and understand the consistency of the present engineering curriculum practices and its implementation with the perspectives of stakeholders;
- To determine what the participants consider as major influences of curriculum development process in engineering education in the Ethiopian context;

- To identify the challenges and opportunities that may prevail in the process of the engineering curriculum development and its practices.

1.5. The Research Questions

2. Why was the engineering curriculum reform initiated? How was it developed?
3. How do deans, teachers and students view and describe engineering curriculum and the congruency between the curriculum expectations and its implementation?
4. What are the factors that influenced engineering curriculum development?
5. How do employers assess their involvement in curriculum design process and in its relevance? What are their expectations of the new engineering graduates in terms of their knowledge, skills, and competencies?

1.6. Scope of the Study

The study is bounded in time, location of the study, participants of the study, and the programs of study. In terms of time, it covers the engineering curriculum development process and practice staring from 2005 to the time this research was conducted. In terms of the number of institutions it covers three engineering higher education institutions, that is, one School of Technology within a university setting and two Institutions of Technology (IoTs) selected from among the ten institutions available in the country. In terms of participants, the study is delimited to those purposely selected deans, teachers, and students of institutes/schools, and few representatives from industry and MoE because they are regarded as having better knowledge of the subject and are assumed to be affected by the program directly or indirectly. In terms of the programs of study (fields of studies), the research is bounded to teachers and students of the long existed fields of studies, that is, Civil Engineering (CE), Mechanical Engineering (ME), and Electrical Engineering (EE) within the three sites of the study.

1.7. Limitations of the Study

The qualitative case study method used in this study is believed to be more appropriate in investigating and explaining the problem identified by the researcher and to answer the research questions raised. One of the limitations in this study is the limited use of local research and other materials on engineering education and curriculum development due to its unavailability. Hence, the researcher was forced to rely more on materials of outside origin. Secondly, though this researcher is aware of the use of modern technologies such as NVivo, ATLAS.ti, HyperRESEARCH, and the like, for qualitative data organization and data analysis, the effort made to get access to and make use of such software was not successful because of its unavailability.

1.8. Significance of the Study

Currently, provision in engineering education is the highest priority in the Ethiopian higher education system due to the government’s policy. Based on this policy and other accompanying guides, many of the students joining higher education enroll to the fields of engineering. Since 2006/2007 academic year, new and reformed curricula have been introduced within the engineering institutions and a number of students who have been educated with these curricula have already graduated and the rest are in the pipeline. This is a clear sign that the policy is heading positively towards meeting the goal at least in availing the number of engineers needed.

However, past experiences, in the context of Ethiopia, do not show that there is rich experience of research in engineering education in general and particularly in curriculum development. Hence this researcher believes that the results of this study can contribute significantly to the body of knowledge and empirical findings as related to engineering education and curriculum development process and its practices in the Ethiopian context, particularly in the three sites of the study. The citations included throughout the material and the rich review of the related literature in Chapter Two can provide the different perspectives and orientations upon which engineering education curriculum development rests. The research will also benefit engineering teachers and students by way of acquainting them with the recent information related to the knowledge, skill, and attitude that are useful and required of the present and the future engineers and to focus their activities of curriculum development, teaching and learning, and assessment within their respective fields of studies along current and new line. It, in addition will be important for policy makers and planners to be more cognizant of the essential or the required components of the present and the future engineering education and to consider the appropriate and indispensable inputs during their policy making and planning. Since industry is the consumer of the final products of engineering education, it will also be one of the beneficiaries by way of being informed what is being practiced within the engineering institutions, in terms of teaching learning and how its implication affects the engineering profession.

1.9. Theoretical Framework and its description

Theories and concepts of education, curriculum, curriculum development and student learning in general, and the literature on engineering education related to curriculum development in particular provide the theoretical bases for understanding the nature of curriculum in general and the curriculum development process in engineering education in particular. Crew, Wickson, & Radcliffe (2006) indicate that:

> *Engineering education research is a transdisciplinary endeavor in both a literal sense (in that it draws on knowledge from the disciplines of engineering and education), and in a formal theoretical sense, given that transdisciplinarity is defined as problem solving through 'the context specific negotiation of knowledge'* (Carew, Wickson & Radcliffe, 2006: 1).

Curriculum development process in this study is seen as a process that strives for answering the question of how a curriculum is planned, implemented and evaluated, as well as what people, processes and procedures are involved (Ornstein & Hunkins 2009: 15). Based on the review of related literature of different nature, that is, on the concept of curriculum, curriculum development process and its practices, learning theories in general, and on the curriculum development process and practices of engineering education in particular, the researcher has dealt with the following theoretical considerations to serve him as the base for understanding what is known about the area on which the research focuses.

For a better understanding of the concept, nature and assumptions underlying the study of the curriculum development process and its practices in engineering education, and the factors that may affect its processes and practices are pointed out in the schematic representation which is depicted herein under; and which includes a brief description of each of the specific areas included in the framework are also briefly highlighted.

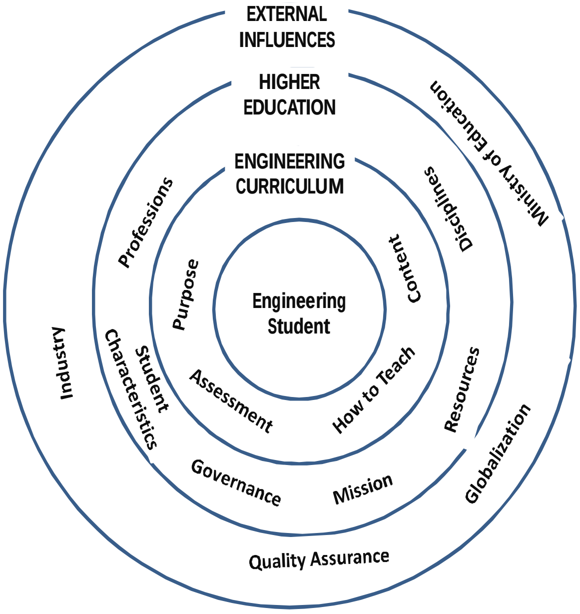


Figure 1. Engineering Curriculum Development Process Conceptual Framework

The framework shows that the engineering student is at the center of the curriculum development process and its practices. Everything that is manifested in any curriculum should be connected with and has to point towards students' learning and should contribute directly or indirectly to its success (Ratecliff, 1977; Fraser & Bosanquest, 2006). The second inner circle shows the generally accepted components of the curriculum, which mainly structure the curriculum used to shape the engineering student (Felder, Rugarcia & Stice, 2000). The "purpose" which, in the context of this study, refers to why engineering education is provided, and the "content" which, refers to the materials and practices which are intended to enable the student to be knowledgeable and skillful and do whatever he/she wants to do, the “how to teach” which refers to the mechanism by which the materials and practices are made available to the student and the communication that takes place within the classroom situation which is actually the method of teaching, and the “assessment” refers to the mechanism by which the overall achievement in the process of curriculum development and its practices is gauged -all these refer to the engineering student and the outcomes their after (Haywood, 2005; Knowles, 1973; Felder & Silverman, 1988; wankat & Oreovicz, 1993; Felder, Rugarcia & Stice; 2000, Felder & Henriques, 1995; Berthiaume, 2003; Marton & Booth, 1977; Ornstein & Hunkins 2009; Beyer & Apple, 1998; Biggs, 2003; Morgan & Houghton, 2011; Felder, 2012; Wray, 2013).

The third circle (from the middle) shows that the curriculum development process and the practices of engineering education, in many ways, cannot be free from the influences that affect the curriculum development process and its practices in higher education and what happens in higher education in general. This means the curriculum development process of engineering education and its practice is, somehow, influenced and embedded within the overall curriculum development process and practice of higher education and is influenced by what happens in it (Lattuca and Stark, 2009; Crawley, et al. 2008; Pister, 1993) This is true in the case of Ethiopian engineering education and probably similar elsewhere. For instance, the engineering profession and engineering education, in general, make the use of materials from other “disciplines” such as mathematics and other sciences. Moreover, engineers live and work with people, make business and make communications with people and the total environment which necessitates the use of materials and knowledge from other disciplines such as the social sciences.

The curriculum development process of engineering education and its practices, like any other education, if not more, also requires a variety of material, physical, and human “resources” for its proper functioning without which the creation of the needed engineer becomes under a question mark in quantity and quality. The other thing considered in the framework is “mission”. “A mission statement should be the emotional hook which an institution hangs its closing” (Haywood, 2005: 4). Though it is possible for engineering education curriculum development and its practices to have a specific mission peculiar to it, it cannot totally deviate from the overall mission of higher education and somehow be influenced by what is going in it. In addition, the curriculum development process and its practices in general have to come into effect through intelligent, knowledgeable, and skillful leadership. It is a common practice in many sectors, including education, to see the premature fading of beautifully designed plans due to inappropriate leadership and governance. The curriculum development process and practice in engineering education cannot be exceptional to function without being backed with the required leadership and the governance system and practice committed to its materialization. The availability or unavailability of such system at the higher education system level and at the institutional level, in many ways affects the overall curriculum development and its practices.

Engineering education institutions receive their student population from all the schools available in the wider community. Schools at different areas are not the same in their capacity of providing similar education in similar depth, due to different reasons which perhaps pertain to material, physical, and human resources (in terms of the number of teachers and the qualifications they may have). This inevitably creates variation in the students' high school educational background which necessitates bringing and reconsidering the case during curriculum development processes and its practices.

Engineering education, like any other disciplines in higher education, has professionals who strive for maintaining the academic rigor and the scientific quality of the discipline. Functions attached to the discipline, other than that of maintaining such a rigor and keeping the scientific development of the discipline, are sometimes not in agreement with people who would think that engineering education has to produce graduate engineers who would automatically be capable of doing engineering tasks in the real world. The prevalence of such a case somehow can have effect on the curriculum development process and its practices since it entails making choices.

What is shown in the outer most circle of the schematic representation above refers to the outside forces that may put an effect in one or other way on both the higher education system in general and the engineering curriculum and curriculum development process and its practices within particular institutions in particular. These days many countries are trying to produce and advocate for professionals who are capable of doing things in settings other than the setting they are trained for, provided that they maintain the necessary qualification skill and attitude standards. It is argued that engineering education must respond to local challenges as well as global opportunities (Morell, 2008). While this framework is used as a guide to understand what is generally known and related to the field of curriculum development and its practices in engineering education, the qualitative multiple case study research design is described in chapter three of this dissertation and provided the base for the empirical study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1. Introduction

This part deals with the review of literature related to higher education particularly geared to engineering education and its curriculum development process. It begins with the concept and issues of higher education and higher education curriculum development in general and continues to deal with the specific issues related to the issues and concepts of engineering education and curriculum development. Kelly (2004) posits that "one family of issues we must concern ourselves with is that of the lessons which have been learned from the many attempts which have been made to change the curriculum" (Kelly, 2004: 11-12). The review, in general is divided into three major parts. The first part, deals with an overview of the concepts and issues involved in higher education. The second part deals with the concepts and issues related to engineering and curriculum development. Finally, the third part deals with an overview of the development of the education system in Ethiopia.

2.2. Higher Education

Some scholars claim that higher education as a field of study is a "relatively new concept" (Noumi, 2007: 3) which does not encompass a specific body of knowledge and which may be considered as a multidisciplinary subject. Higher education mostly refers to the kind of education provided within or under the settings of universities and colleges. Huber and Harkavy (2007) stipulate that:

The University of the Twenty-first Century is both the essential agent and the distinctive servant of democracy. It is the agent, because its continuing activities nurture deliberation and promote the democratic spirit. It is the servant because, at its best, each of the members – faculty, staff, students, alumni –dedicates his or her professional skills to serving the wider common goal (Huber and Harkavy (2007: 42)

In other words, Giroux (2015) contends that higher education "must be widely understood as a democratic public sphere- a space in which education enables students to develop a keen sense of prophetic justice, claim their moral and political agency, utilize critical analytical skills, and cultivate an ethical sensibility through which they learn to respect the rights of others" (Giroux: 110).

These days, many people attend higher education more than ever. Meyer, Francisco, Richard, and Boli-Bennett (1977), in their cross-national study of tertiary enrollment ratios from 1950 to 1970, found very rapid increases in enrollments in all types of countries. Any institution of higher education is a community dedicated to the pursuit and dissemination of knowledge, the study and clarification of values and to the advancement of the society and its services. The missions of higher education that contribute to social and economic development in the sense of Santiago (2008) are stated as follows:

- *Formulation of human capital (primarily through teaching);*
- *The building of knowledge bases (primarily through research and knowledge development);*
- *The dissemination and use of knowledge (primarily through interactions with knowledge users); and*
- *The maintenance of knowledge (inter- generational storage and transmission of knowledge)* (Santiago, et.al, 2008: 11).

Higher education curriculum around the world is witnessing a significant shift in its expectations to help address immediate and longer-term sustainable development challenges. The sector of higher education, at present, is facing a new era of different reforms and concerns about the quality of education in its institutions and it has become a pressing need for states and society since these institutions are aimed at preparing suitably qualified graduates that have the skills and competencies required by the labor market. Quality in higher education is also believed to be "a multidimensional concept, which should embrace, all its functions, and activities: teaching and academic programs, research and scholarship, staffing, students, buildings, facilities, equipment, services to the community and the academic environment" (UNESCO, 1998b).

Curriculum development is a key educational process for educational developers for schools and for higher education (HE) as it allows an educational course to be designed to meet defined needs. Curriculum development cycles in Higher Education Institutions

(HEIs) have in general become more rapid due to many factors including competition between institutions and the expectations of government, employers and students that higher educational program will provide the most contemporary knowledge in a particular discipline (Roffe, 2010). Since the end of the Second World War, there has been a growing demand to widen access to higher education and change the elitist nature of universities (Guri-Rosenblit, & Sebkova, 2004: 41). This implies that higher education curriculum has to be directed towards meeting societal needs and aspirations in every case. However, it is argued that education cannot be value-free and different value systems or ideologies generate different types of curricula.

The present universities situated all over the world by large have their roots back in the medieval European historical origin and hence “face common contemporary challenges” (Altbach and Davis,). The profound change that became a reality in higher education in the past two decades had made those to grapple with the implications of these changes. Academic institutions and systems have faced pressures of increasing numbers of students and demographic changes, demands for accountability, reconsideration of the social and economic role of higher education, implication of the end of the cold war and the impact of new technologies among others. In other words, the shape and the size of the national higher education systems, as rightly pointed out by Teichler (2004) “are on the crossroads of external expectations and internal dynamics of higher education and are shaped by legitimate influences and interests of society at large” (Teichler, 2004: 2).

The mission of higher education includes educating, training, and undertaking research (UNESCO 1998). If not the latter, the concept of ‘educating’ and ‘training’ obviously entail the use of curriculum because there is no formal education and training which assumes the functioning of an educational institution without the use of some kind of curriculum. Karseth (2006) points out that there are different stakeholders at the international, national and institutional scene: hence, curricular questions are positioned on a “macro”, “meso” and “micro” level and represent contesting and conflicting perspectives (Karseth, 2006).

Irrespective of the bases on which higher education rests and the purposes assumed to it including the efforts made to improve it, it seems that the results are not to the level of satisfaction envisioned by those who are involved in it. For instance, At present," one of the mechanisms underlying policy convergences is the shift in many countries from an emphasis on social or mixed social and economic purposes for education, to predominant economic emphasis" (Ball, 1999).

2.2.1. Curriculum in Higher Education

Even though there is a wide recognition of higher education as an important undertaking in every society and the subsequent growth and development in the infrastructure that allowed and gave opportunity for many people to join it, in many parts of the world, "there is little talk about the curriculum in higher education" (Barnett & Coate, 2005: 1). While the term curriculum is familiar in school education, it seems more ambiguous in its usage in higher education context. As pointed out by Hicks (2007), it is a term given very little currency. "What students should be experiencing is barely a topic for a debate". What building blocks of their courses might be and how they should be put together are even more absent from the general discussion (Barnett & Coate, 2005: 1). To Barnett and Coate "the very idea of curriculum is pretty well missing". Although it is frequently used in academic staff discussions, policy and planning documents, and to describe advisory bodies, its usage is inconsistent and multifarious (Fraser & Bosanquest, 2006) and it seems that the meaning of such a well used word shifts across contexts.

Karseth (2006) views the curriculum in higher education as a social construction where the process of decision-making is seen as socio-political and a cultural process, and contends that "curriculum as a field of study has not played a central role in the research literature on higher education in Europe" (Karseth, 2006: 256). In the United States, at the program level, undergraduate curricula typically consist of three to four components i.e., general or liberal studies, major specializations, which are prescribed by the particular department or program offering the specialization (Spink & Mal, 2013: 33). On the other hand, in professional faculties such as engineering or law, the major and minor fields may be governed by the curricular prescription of the professional field represented or by guidelines extended by the disciplinary associations, or by state licensure requirements or professional board examinations.

In connection with college education, Lattuca and Stark (2009: 4) define the term curriculum as an "academic plan", which implies deliberate planning process that focuses attention on important considerations, and which will vary by field of study, instructors, students, instructional goals and other things. In other words, curriculum, in the context of higher education, is viewed as "the formal academic experience of students pursuing baccalaureate and subordinate degrees" (Clark & Neave, 1992:1566). According to Clark and Neave, undergraduate curriculum is formalized into courses or programs of study including workshops, seminars, colloquia, lecture series, laboratory internship, and field experiences. Course, in this sense, generally refers to designate a formal unit of undergraduate curriculum. These authors also contend that the organization and structure of higher education curriculum is significantly influenced by the historical, social, political and economic contexts of each country in the face of the debate concerning what should be the purpose, content, and structure of undergraduate curriculum. The debate, however, varies in meaning and direction between the developed and the less developed nations. However, within higher education, a faculty member, who organizes a course that refers to a formal unit of undergraduate program, generally controls the purpose, process, and content. Similarly, Ratcliff (1997) defines 'undergraduate curriculum' as:

> *the formal academic experience of students pursuing baccalaureate and less than baccalaureate degrees. Such a curriculum is formalized into courses of programs of study including workshops, seminars, lecture series, laboratory work, internships, and field experiences* (Ratcliff, 1997:6).

This means that the term curriculum in higher education is used either in a limited 'content' focused discussion or it is used as a vehicle for discussion of a particular issue. However, there are definitions of the term 'curriculum' specifically geared to the situation in higher education. For instance, Fraser and Bosanquest (2006), in their study that included 25 interviews found that the term curriculum is conceptualized at four categories:

> *Category A: The structure and content of a unit (subject);*
> *Category B: The structure and content of a program of study;*
> *Category C: The students' experience of learning;*
> *Category D: A dynamic and interactive process of teaching and learning*.

According to these researchers, categories of understanding A and B they conceptualize the curriculum as a product that can be defined and then recorded on paper. These views of curriculum focus on what the teacher as an individual teaches to students, that is, a unit or subject, but also may incorporate the whole program of study undertaken by a student. In category C understanding curriculum is conceptualized as a process and structure that enable student learning, and category D views curriculum as a dynamic, emergent and collaborative process of learning for both students and teachers. The researchers, using the Habermas's theory of 'knowledge-constitutive interest', as expounded by Cornbleth (1999), Grundy, (1987) and Kemmis and Fitzelarence (1980) also analyzed the curriculum in view of technical interest, practical (communicative) interest, and an emancipator interest.

2.2.2. Curriculum Development in Higher Education

Post modern curriculum development in higher education is not seen as permanent but as creative and fluid (Oliver & Hyun, 2011) and it does not focus on specific steps in curriculum development but instead on the relationships of people involved in the process of creating curriculum (Tierney, 1989). Higher education curriculum has historically been considered the work of the faculty. More recently, however, external influences such as society, government, alumni, and others are affecting curriculum development and the curricular change process (Stark & Lattuca, 1997, pp. 98-100).

These days, accreditation bodies expect more from higher educational institutions especially in the area of assessment of student learning in many countries. Such external influence has caused a number of educational institutions to engage in curricular review in an effort to identify the desired student learning outcomes (Alstete, 2004; Lucas, 2000; Wolf & Hughes, 2007). External influences such as Washington Accord (WA) (1989), which is involved in the accreditation of qualifications in professional engineering, the Sydney Accord (SA) (2001) which recognizes equivalence in the accreditation of qualifications in engineering technology, The Dublin Accord (DA) (2002), which is involved in the accreditation of tertiary qualifications in technician engineering can be cited as examples of major influences in this regard.

Curriculum in higher education is usually adapted rather than adopted (Lindquist, 1978 in Clark & Neave 1992: 1574). This is done by any faculty who manage to identify the difference (gap) between what the current curriculum provides and what they think it should provide to the student.

2.2.3. Curriculum Models in Higher Education

As it has been pointed out earlier in this study, the way we conceive the term curriculum determines how curriculum is developed and who is involved in the curriculum. For example Bergquist (1977), based on the rational perspective of curriculum, identified the following curricular models in higher education:

1. *Heritage based: A curriculum designed to inculcate students with a knowledge of the past*
2. *Thematic Based: a specific problem (such as the environment) is identified and studied in-depth.*
3. *Competency Based: students learn specific skills such as proficiency in language and mathematics.*
4. *Career Based: the curriculum is designed to prepare students for a specific career.*
5. *Experience Based: Opportunities are created for the student to learn outside of the classroom.*
6. *Student Based: the curricular emphasis is on providing students with opportunities to control what they learn.*
7. *Value Based: The curriculum emphasizes specific institutional values*
8. *Future Based: the institution divides the curriculum with a concern for what students will need in the future* (Bergquist, 1977: Cited in Tierney, 1995: 35)

Curriculum making, in any way, is not a linear process (Karseth, 2006: 278). A piece of change effected at one level has consequences on other levels, which goes beyond those that are intended to be achieved at the end. However, It has been argued that higher education rests upon two curriculum models, that is , 'the disciplinary model', and the 'vocational/professional model' (Karseth, 2006: 257). According to Karseth, the disciplinary model has been dominant in university curriculum, although with important exceptions and the vocational model has been traditionally linked to the college sector and undergraduate professional programs. A summary of the disciplinary curriculum model is provided by Karseth (2006) in the following table, (Table 1).

Table 1. Disciplinary Curriculum

Disciplinary curriculum Driving force: The knowledge production itself (cognitive legitimation)			
Structure	Content	Pedagogy	Aims
The disciplines situated in Departments «Subjects» offered on foundational, intermediate- and graduate level	Disciplinary knowledge Emphasis on cognitive coherence	Subject-based teaching Vertical-pedagogic Relations	Content-driven aims, Mastery of conceptual structures, methods and modes of arguments

Source: Karseth (2006: 259)

As pointed out by Karseth (2006), in the disciplinary discourse the main educational pillar is the knowledge structure of the discipline. The central aim is the apprenticeship into conceptual structures and modes of arguments. Hence, education implies a strong emphasis on students' acquisition of theoretical knowledge.

On the other hand, Karseth (2006) contends that the discourse shaping the vocational curriculum model is enunciated by stakeholders who emphasize that education should be an apprenticeship into specific knowledge domains in order to develop specific skills relevant for specific professions as summarized in the following table, (Table 2)

Table 2. Vocational Curriculum

Vocational curriculum Driving force: The need of trained employees for human service, information and production (social legitimation)			
Structure	Content	Pedagogy	Aims
Unified cumulative programs Regulated by national core curricula	Multi-disciplinary knowledge Emphasis on the integration of theory and practice	Teacher-based/subject based teaching Apprenticeship: Vertical-pedagogic relations	Vocational-driven aims Mastery of specific skills and a shared knowledge repertoire

Source: Karseth (2006: 260)

According to Karth (2006), the dominant discourses in higher education up to now can be characterized by the two models presented above. Nevertheless, models other than these two also become part of the discourse in higher education. The multidisciplinary model

(Jarning, 2012) in this sense can be seen as an effort to balance professional and disciplinary knowledge cultures. Nevertheless, the two models, that is, disciplinary model, and the vocational/professional models, are being challenged by models such as the multidisciplinary model and by a credit accumulation and transfer discourse advocating global competition and European cooperation (Karth, 2006). As mentioned, modularization is a key characteristic. Its function is to disaggregate traditional extended higher education courses; the specification of outcomes allows modules to be evaluated against each other for the purpose of equivalence. Ensor (2004) argues that the specification of learning outcomes in the credit exchange discourse is not first of all an effort to address issues of quality. It is an attempt to provide mechanism to facilitate the circulation of knowledge in an organized framework.

2.2.4. The Curriculum Development Process and Design in Higher Education

Though little attention has been given to the evolution of curriculum and its review and transformation in institutions (Oliver & Hyun, 2011), higher education curriculum has historically been considered as the work of the faculty. Although colleges and universities are not passive recipients of social pressures, "external influences such as society, government, alumni, and others are affecting curriculum development and the curricular change process" (Lattuca & Stark, 2009: 301).

On the other hand, Oliver & Hyun (2011), in their case study that involved an in-depth interview with 10 curriculum review team members, with regard to the phenomenon of a four-year collaborative curriculum review process between administration and faculty at a higher education institution, showed that a collectively shared guiding vision for the curriculum provided a strong foundation for the comprehensive curriculum review process. Embracing curriculum as a shared responsibility among faculty and administration has led to widespread participation. The collaboration of various groups within the institution in the process promoted organizational change. Cultural issues regarding people and organizational structure served as barriers to the collaboration process, simultaneously the curriculum team's sense of community strengthened the curriculum review process (Oliver & Hyun, 2011).

Beyer and Apple (1998), though not directly related to the curriculum development process in higher education, indicate that "the hallmark of too much curriculum development" had been "insistence on hierarchical top down model of conceptualization, development, and implementation" which they found it intellectually and politically dishonest (Beyer, & Apple 1998: 6). They also clarify that such a "stratified curriculum", which, according to them, is developed by "academics in higher education, research and development agencies and state, and federal departments of education" is a superimposition on teachers.

2.2.5. Curriculum Change and Design in Higher Education

It has been mentioned in the preceding parts of this literature review that there are different curriculum designs which are based and informed by different views and perspectives. Recent development in curriculum design touches every aspect of an institution's core business – from aligning its portfolio of courses to its mission and vision, through market research and product development to quality assurance, recruitment, assessment, resource allocation and timetabling. In this modern era of the 21st century, institutions aim to be increasingly demand led, responsive to cultural and economic change, and capable of providing opportunities for learners to acquire both knowledge and skills for employability and lifelong learning. Joined up, adaptive processes and interoperable systems are vital to the realization of these aims.

One of the curriculum designs pertaining to higher education which is promoted by Morgan and Houghton (2011) and accepted by some other higher education institutions is "inclusive curriculum design in higher education". Inclusive curriculum refers to "the process of developing, designing, and delivering programmers of study to minimize the barriers that students, regardless of educational, dispositional, circumstantial, or cultural background, may face in accessing and engaging with the curriculum" Morgan and

Houghton think that “inclusive curriculum design benefits both staff and students when it is based on principles of equity, collaboration, flexibility and accountability” (Morgan and Houghton 2011: 5). Inclusive curriculum design considers cost and financial implications, embedding student and staff well-being, promoting student engagement, use of technology to enhance learning, responding to different approaches to learning, avoiding stereotypes and celebrating diversity, making reasonable adjustment (Wray, 2013). A number of drivers for change derived from legislation, policy, regulation and procedural requirements constitute a wider context for the inclusive design process.

Curriculum change in higher education may be initiated by those who are involved in planning, administering and implementing a curriculum and somehow dissatisfied in its effectiveness or by those who seek either minor adjustments or major improvements in the existed curriculum. Change in curriculum may also be influenced by external influences. External influences sometimes create “strong current for change” which may or may not be readily accepted by colleges and universities which are not usually regarded as “passive recipients of societal pressures” (Lattuca & Stark 2009: 301). One way of understanding the scope of curricular change, according to Lattuca and Stark, is to consider the extent to which a given change will influence institutional practices. Depth and pervasiveness are identified as measures of such influence. Depth refers to the extent to which a change affects behavior or alters institutional structures, especially those which are capable of changing ones perceptions, values, and assumptions. But such changes are not necessarily wide spread and may affect only a small number of students and faculty in the institution. On the other hand a pervasive change refers to the kind of change that affects many units within a college or university. The following matrix which is adapted by Lattuca and Stark (2009: 304) from Eckel, Hill, and Green (1998) combines these two elements of change.

		Depth	
		Low	High
Pervasiveness	High	Adjustment (1)	Isolated change (2)
	Low	Far-reaching change (3)	Transformational change (4)

Figure 2. Types of Change

Source: Lattuca and Stark (2009: 304)

Routine works of faculty such as making adjustments to existing courses by modifying course content, sequence, instructional processes fall in Quadrant 1. Such adjustments, though they may represent improvement, they may not substantially change the overall academic plan or the learning experiences of students. The type of change identified in Quadrant 2 refers to isolated changes which are high in depth but low on pervasiveness. This type of change refers to a specific type of change applied in one or two units of the institution; not in the entire institution. A change program, such as an online education, when applied across the board within institutions can result in far-reaching change (Quadrant 3). A change type that alters the teaching learning process and the experiences of many students and instructors is termed as transformational change (Quadrant 4).

However, change in curriculum, at the present era, seems to be highly influenced externally by social, cultural, political, and economic demands. A simple illustration of this, without going far away, can be seen from what is stipulated at policy level with regard to the Ethiopian higher education institutions at present. The Convergence Plan adopted in 2008/2009 provided guidance when establishing the 70% and 30% placement objective for sciences & technology (S&T) and social/human sciences (SHS) that forced almost all higher education institutions and universities to work in line with it and restructure their existing programs and/or create new programs and curricula. As a result of implementing this plan, a number of programs/curricula that existed within institutions or within universities faced closure or became malfunctioned. Though not possible to generalize, a large number of undergraduate programs which are provided in public and private higher education institutions hence, have to respond to and/or contribute to the social, cultural, political, and economic needs as per the needs of the country identified by the authorities above.

Curricular change often occurs by diffusion (Lattuca and Stark, (2009). In diffusion theory the movement of influence across the boundary between institutions and their environments can be viewed as stages in change process which includes imitation (or awareness), screening (adaptation), and adoption (confirmation). At the initiation stage of recognition or initial public pressure, external pressures are strong but organizations may resist change, because the need for change is not fully recognized or simply because of organizational inertia. The second stage, which is adaptation, often begins by converting the external influence into an institutional influence. The last stage of adoption or confirmation is reached when the degree of acceptance is sufficiently great and when the influence may no longer be viewed as external; it is now part of the institution's agenda.

2.2.6. Teaching and Learning in Higher Education

In any formal educational setting, particularly where the actual implementation of the curriculum takes place the direct actors in the process of education are teachers and students. In this process, teachers deliver or initiate materials that contain new concepts and principles that are not well known or that are not learned by the students before, to be learned, and students learn what is presented or initiated by the teacher together with whatever more they want to lean. In fact, students learn in many ways—"by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing" (Felder & Henriques, 1995: 22). Though the "heart of education is learning, not teaching" (Knowles, 1973: 41), it is an inevitable fact in any formal education that the teacher takes the lead in initiating the discussion and presenting the materials of learning. Hence, the following part deals with a brief description of the teaching learning process in higher education.

As it has been mentioned elsewhere in this review of literature, teaching involves an interaction between an individual who is involved in teaching something to someone; usually to a group of people who are available to learn that something. Any teaching staff in higher education knows that it is not so easy to decide what works and what does not work in the teaching learning process. Unfortunately, teaching staff in higher education, in most cases, are often left to develop their understanding of the teaching profession on their own (Berthiaume, 2003: 215). It is also a recognized fact that some academics teach students without having much formal knowledge of how students learn (Fry, Ketteridge, & Marshall, 2009: 8). Teaching in higher education draws on knowledge of three areas, namely knowledge about one's discipline, generic principles and ideas about teaching and learning. An awareness of the theories of learning can provide some insight into understanding how university or higher education students learn. Most of the learners in higher education are young adults whose age is 18 and above. The theory of Andragogy (Knowles, 1973) informs us that adult's individual self-concept, experience, readiness to lean and orientation to learning differs from that of children's below adult age. The same theory also points out that:

> *as an individual matures, his need and capacity to-self directing, to utilize his experience in learning, to identify his own readiness to learn, and to organize his learning around life problems, increases steadily from infancy to pre-adolescence, and then increasingly rapidly during adolescence* (Knowles 1973: 46).

As students mature, it is likely that sharp contrasts develop between their present and their childhood learning styles. These differences occur in motivation, in learning skills, in amount and variety of knowledge, in desires for learning, in self-concept and in need for immediacy of application. Teaching such students, is not an easy task for it requires a special attention commensurate to the needs students have.

Available literature in higher education also indicates that recently more attention is given to the quality of teaching offered to the students in higher education. The advent of mass higher education, the value for money and public accountability, and the change in the student body produced a shift in the conception of the role of universities. Brennan, King and Lebeau (2004) recognize that universities are as much the 'takers' of change as its agent, and are influenced by globalization, democratization, 'supra-statism' and modeling, knowledge economies, liberalization, regulation and accountability.

And yet the question of quality in education is one of the central questions that capture the mind of all stakeholders in higher education. Quality teaching depends on the meaning one chooses to give to the concept of quality. Quality, as pointed out by Biggs (2001) can alternatively define an outcome, a property, or a process. When it comes to quality teaching, Harvey and Green (1993) distinguish four definitions of quality that can help us to understand what Quality Teaching might be; that is, quality as "excellence"- which is dominant in many old elite higher education institutions, quality as "value for money"- one that satisfies the demands of public accountability, quality as "fitness for purpose" that refers to the purpose of the institution, and quality as "transforming". According to this definition, Quality Teaching is teaching that transforms students' perceptions and the way they go about applying their knowledge to real world problems. Hau (1996) argues that quality in higher education and quality teaching in particular, springs from a never-ending process of reduction and elimination of defects.

Different teachers use different methods in their teaching. For some teachers lecturing is more convenient while others prefer demonstrating or conveying student discussion. Others may prefer focusing on principles while some others deal with applications. Some emphasize memory and others understanding. However, "how much a given student learns in a class is governed in part by that student's native ability and prior preparation but also by the compatibility of his or her learning style and the instructor's teaching style" (Felder & Silverman, 1988: 674). Research on teaching styles at all levels of education suggests that individuals' beliefs about teaching are deeply held and enduring, even when those beliefs are contradicted by reason, experience, and schooling (Floden, 1995: cited in Lattuca & Stark, 2009: 184). Hence, knowledge about how students learn can be regarded as the most crucial element for teaching students of varying ages including students in higher education.

2.2.6.1. Learning in Higher Education

When talking about learning in higher education, we are talking about individuals whose age is eighteen years and above. As it has been mentioned in the preceding part of this discussion adult's individual self-concept, experience, readiness to lean and orientation to learning differs from that of children's below adult age. In a structured teaching and learning setting, learning is thought as a two-step process involving the reception and processing of information (Felder and Silverman, 1988).

Learning is about how we perceive and understand the world, about making meaning (Marton and Booth, 1997). But 'learning' also involves mastering abstract principles, understanding proofs, remembering factual information, acquiring methods, techniques and approaches, recognition, reasoning, debating ideas, or developing behavior appropriate to specific situations; it is about change (Fry, et al. 2009). However, despite many years of research into learning and suggestions of various natures, it is not easy to translate the knowledge obtained through research into practical implications for teaching. So far, there are no simple and clear answers to the questions 'how do we learn?' and 'how as teachers can we bring about learning?' (Wankat & Oreovicz, 1993). This is partly because education deals with specific purposes and contexts that differ from each other and with students as people, who are diverse in all respects and ever changing and which is more evident in the Ethiopian situation than any place with less diversity. Not everyone learns in the same way, or equally readily about all types of material. The discipline and level of material to be learnt have an influence. No matter in which level they are, students always bring different backgrounds and expectations to learning. Our knowledge about the relationship between teaching and learning is incomplete and the attitudes and actions of both students and teachers affect the outcome, but we do know enough to make some firm statements about types of action that will usually be helpful in enabling learning to happen. In this chapter some of the major learning theories that are relevant to higher education are introduced.

2.2.6.2. Assessing Student Learning in Higher Education

Irrespective of the variety of meanings attributed to it, the term assessment usually refers to the systematic collection and analysis of information to improve student learning. Lattuca and Stark (2009) refer to the evaluation which is aimed at decision making, improvement, and the planning of future courses and programs as "formative". Such evaluation, according to these authors, "may include measurement of student outcomes (assessment) and satisfaction (student-centered evaluation) as well as estimates of how faculty themselves believe the plan (professional judgment)" (Lattuca & Stark, 2009: 233). Formative evaluation often arise from faculty initiative and the procedure used to perform it may range from informal to formal and from unstructured to structured.

The word "assessment" has taken on a variety of meanings within higher education. The term can refer to the process faculty use to grade student course assignments, to standardized testing imposed on institutions as part of increased pressure for external accountability, or to any activity designed to collect information on the success of a program, course, or university curriculum. Formative assessment is a process in which teachers use various tools and strategies to determine what students know, identify gaps in understanding, and plan future instruction to improve learning. Biggs (2003) suggests the alignment of teaching and assessment to curriculum objectives. According to Biggs, the integration of teaching and assessment, which he calls Constructive Alignment (CA), supports high level learning. Different forms of assessment, from performance-based to multiple-choice items can be used in formative assessment. These may include journals, checklists, written papers, and other relevant techniques. The time for assessment ranges from minutes of assessment to hour/s taking tests and examination. The learning point associates (2009) describe the purpose of assessment as follows:

> *The purpose of the assessment items, tasks, or activities must be that they are windows into the students' cognitive processes. Assessments that allow students to show their thinking, and allow teachers to best elicit evidence about these cognitive processes, are where the emphasis should be* (Learning Point Associates, 2009: 1).

In general, it can be said that assessment deals with identifying the gap between what students have to learn and what they actually learned. Its purpose is mainly to give feedback to students so that they could improve their learning and improve the quality of their education.

2.3. Engineering Education

Engineering education, irrespective of its peculiar characteristics, as part of higher education, shares much of the common attributes discussed in connection with curriculum and curriculum development, especially as related to higher education. The Merriam Webster Dictionary defines the term "engineering" in various ways, one of which is "the activities or function of engineer", where an engineer is defined as "designer or builder of engines" or "a person who is trained in or follows as a profession a branch of engineering". Engineering is also understood as the application of science to the optimum conversion of the resource of nature to the uses of humankind (Smith, 1962).

Engineering, in the sense of UNESCO is the field of discipline, practice, profession and art that relates to the development, acquisition and application of technical, scientific and mathematical knowledge about the understanding, design, development, invention, innovation and use of materials, machines, structures, systems, and processes for specific purposes (UNESCO, 2010). Engineering and technology are critical inputs for economic development and competitiveness hence, a nation's educational program should, among other things, be aimed at solving the problems facing the nation and improving the economy through wealth creation (Luiz, et al. 2004).

Higher education institutions, in general, are required to educate and train personalities who would be able not only to think individually and creatively but also to act successfully and compete individually or in groups in both national and foreign labor market. Engineering education as part of higher education occupies one of the central positions in such expectations. Concern about engineering education obviously entails the preparation and equipping of young people to be able, understand and act effectively in the design and production of improved artifacts and modern services through the use of science and mathematics to make the human life easier and comfortable and to contribute to the future development of the engineering profession within the society into which it is provided and beyond.

Richard Felder in his article "Engineering Education: A Tale of Two Paradigms" points out that "Engineering education is in a turbulent period" (Felder 2012: 1). Pressures to reform engineering education have existed since the field first began, but a particularly intense series of them arose in the 1980s and still continues. Felder posit what this means as the following:

> *chronic industry complaints about skill deficiencies in engineering graduates, high attrition rates of engineering students, the worldwide of outcomes-based engineering program accreditation, and deficiencies revealed through the research findings of both cognitive science and many educational research studies are all provoked calls for changes in how engineering curricula are*

structured, delivered, and assessed. The ongoing debate involves four focal issues: how engineering curricula should be structured, how engineering courses should be taught and assessed, who should teach, and how the teachers should be prepared (Felder, 2012: 1).

Felder describes the traditional approach to curriculum as "trust me" didactic approach which begins teaching the first years with basic mathematics and science and proceeds to "engineering science" in years 2 and 3 and finally to realistic engineering problems and practice later in the capstone. On the contrary, the integrated approach suggests to introduce engineering problems and projects starting year one, and bring in the math and science (and communication and economics and ethics) in the context of problems. According to Felder this means the emerging paradigm infuses the entire engineering curriculum with real engineering problems and introduces fundamental material on a need-to know basis in the context of solving those problems (Felder, 2012: 3).

A similar idea is promoted by Prados (1998). In his view, engineering education has to have the needed characteristics of the new engineering paradigm which include:

- *an engineering faculty dedicated to developing emerging professionals-not merely filling empty heads with knowledge*
- *a curriculum that maintains a solid mathematical and scientific knowledge base*
- *an educational structure that integrates subject matter, and shows relationships among subject areas from the beginning of each student's program*
- *educational methods that stress active learning, emphasize industry-based projects, and depend much less on lectures*
- *strong emphasis on communication, teamwork, and group problem-solving skills*
- *a diverse student population*
- *regular, well-planned interaction with industry* (Prados, 1998: 1)..

Engineering and engineering curriculum within higher education system are also perceived in different ways by different people. Dym, Gogino, Eris, Frey and Leifer, (2005), for instance, associate engineering education with graduate engineers "who can design, and that design thinking is complex". These authors consider design as the central or distinguishing activity of engineering and that engineering programs should graduate engineers who can design effective solutions to meet social needs. The definition they provide for engineering design is as follows:

Engineering design is a systematic, intelligent process in which designers generate, evaluate, and specify concepts for devices, systems, or processes whose form and function achieve clients' *objectives or users' needs while satisfying a specified set of constraints* (Dym et. al, 2004: 309).

According to Dym et al, design problems reflect the fact that the designer has a client (or customer) that, in turn, has in mind a set of users (or customers) for whose benefit the designed artifact is being developed. Mourtos, (2013) also considers design as the heart of engineering practice. In other words, for Crawley, et al, the essential task of engineering is to design and implement solutions that have not previously existed (Crawley, et.al. 2008). The purpose of engineering education, according to Crawley et.al, is "to provide learning required by students to become successful engineers, that is, technical expertise social awareness and a bias toward innovation" (Crawley, et. al. 2008: 1). The Conceive-Design-Implement-Operate (CDIO) approach which Crawley et.al promote builds on stakeholder input to identify the learning needs of students in a program and construct a sequence of integrated learning experiences to meet those needs. The CDIO initiative, according to Crawley et.al, was launched in the year 2000 as a major international project to reform undergraduate engineering education. The goals of CDIO, as pointed out by Crawley et.al have been to:

- *Master a deep working knowledge of technical fundamentals*
- *Lead in creation and operation of new products and systems*
- *Understand the importance and strategic impact of research and technological development on society* (Crawley et.al, 2008: 269).

The CDIO initiative has 12 standards that distinguish and describe CDIO programs which were developed in response to program leaders, alumni, and industrial partners who wanted to know how they would recognize CDIO programs and their graduates. The standards were:

Standard 1– *The Context: adoption of the principle that product, process and system lifecycle development and deployment –Conceiving, Designing, Implementing and Operating – are the context for engineering education. (p. 270).*

Standard 2 – *specific detailed learning outcomes for personal and interpersonal skills, and product, process and system building skills, as well as disciplinary knowledge, consistent with program goals and validated by program stakeholders.*

Standard 3 – *integrated curriculum – a curriculum designed with mutually supporting disciplinary courses, with an explicit plan to integrate personal and interpersonal skills, and product, process and system building process.*

Standard 4 – *Introduction to Engineering – An introductory course that provides the framework for engineering practice in product, process and system building and introduces essential personal and interpersonal skills*

Standard 6 – Engineering Workspaces – engineering workspaces and laboratories that support and encourage hands-on learning of product, process, and system building, disciplinary knowledge and social learning
Standard 7 – Integrated Learning Experiences – integrated learning experiences that lead to the acquisition of disciplinary knowledge as well as personal and interpersonal skills, and product process, and system building skills
Standard 8 – Active Learning – teaching and learning based on active experiential learning methods
Standard 9 – Enhancement of Faculty Skill Competence – actions that enhance faculty competence in personal and interpersonal skills, and product, process, and system building skills
Standard 10 – Enhancement of Faculty Teaching Competence – Actions that enhance faculty competence in providing integrated learning experiences, in using active experiential learning methods, and in assessing student learning
Standard 11 – Learning Assessment – Assessment of student learning in personal skills and product, process, and system building skills, as well as in disciplinary knowledge
Standard 12 – Program Evaluation – A system that evaluates programs against these 12 standards, and provides feedback to students, faculty, and other stakeholders for the purpose of continuous improvement. (Crawley et.al, 2008: 270-278).

Engineering education programs, in various contexts and in varying degrees of depth and width, provide students with the knowledge, understanding, skills and competencies required to the professional engineers. The objective of engineering education is to prepare students who are deeply knowledgeable of the technical fundamentals and broadly prepared with the pre-professional skills of engineering (Crawley, et.al, 2008). As pointed out by Rugarcia, Felder, Woods, and Stice (2000), "knowledge is the data base of a professional engineer; skills are the tools used to manipulate the knowledge in order to meet a goal dictated or strongly influenced by the attitudes".

According to Crawley et.al (2008), the proper context for engineering education is engineering practice, that is, lifecycle development and deployment of products, processes, and systems. Engineering education provisions generally include scientific and mathematical theory, engineering applications, design, communication skills and problem solving skills, and so on. The emphasis and the magnitude of the proportion in these elements, however, kept changing over time in the past as well as at present (Lattuca, et al., 2012).

Pister (1993) pointed out that "the practice of engineering in society requires a set of individuals (people) who are subjected to a process called engineering education, whose goals may (or should) include: acquisition of knowledge development of understanding acquisition and application of skills" (Pister, 1993). The modern engineering profession deals constantly with uncertainty and with conflicting demands from clients, governments, environmental groups and the general public. It requires skills in human relations as well as technical competence. Whilst trying to incorporate more "human" skills into their knowledge base and professional practice, today's engineers must also cope with continual technological and organizational change in the workplace (Mills, 2003).

2.3.1. Engineering Curriculum and Curriculum Development Process

The Accreditation Board for Engineering and Technology (ABET) in the U.S. case, refers to an 'Approved Engineering Curriculum' as 'any curriculum under ABET accredited engineering program leading to a baccalaureate degree in engineering'. According to ABET, it is a program leading to a four-year degree or a baccalaureate degree in technology (ABET).

Many writers in the area of engineering education point out that over the last fifty years engineering curricula have been based largely on an 'engineering science' model (Lattuca et al. 2009; Dym, et.al. 2005; Prados, 1998; Felder,). In this model, engineering is taught only after a solid basis in science and mathematics, of which the first two years are devoted primarily to the basic sciences. Such curricula, however, have not been without challenges since the 1950s. Few among other challenges were that engineering graduates who were the results of such curricula were perceived by industry and academia as being unable to practice in industry because of the change of focus from the practical (including drawing and shop) to theoretical (Lattuca, 2006: 5; Dym, et.al. 2005: 103). Hence, what is now identified as the "capstone (design) course" which eventually became the standard academic response which involved projects devised by faculty to industry- sponsored projects and where companies provide "real" problems, along with expertise and financial support. The infusion of first-year design courses that dubbed "cornerstone (design) courses" in 1990s and was motivated by an awareness of the curricular disconnect with first-year students who often did not see any engineering faculty for most of their first two years of study. During this period first-year project and design courses emerged as a means for students to be exposed to some flavor of what engineers actually do while enjoying an experience where they could learn the basic elements of the design process by doing real design projects.

Curriculum is also regarded as the product of the culture and values in which they are embedded (Haywood, 2005). According to Haywood this fact makes the transplantation of educational practices of one country to another is difficult. Haywood in addition identifies three paradigms of curricula in engineering, i.e., 'received', 'reflective' and 'restructuring' after Eggleston (1977). The received paradigm, according Haywood, describes a curriculum organization designed to meet the belief that there is a received body of understanding which is "given" even ascribed. It is predominantly non-negotiable. Most engineering curricula are primarily of this kind, although some negotiation may be allowed, and to this extent they are reflexive" (Heywood, 2005). In other words Petrina (2007) point out that "curriculum and instruction (C&I) are inseparable"

Even though the thinking and skill of "design" is closely associated with engineers, according to Rompelman and Graaff (2006), engineers seldom put their design skills into practice when they are faced with the task to develop a new course program or the innovation of an existing curriculum. According to Rompelman and Graaff (2006), the principles that can be used for any purposeful design can also be applied to curriculum. They suggest that the knowledge and skills that can be applied in the design of any purposeful project can be used for designing curriculum.

In engineering education, writing the aims and objectives or "outcomes" is said to be the starting point for curriculum development (Haywood, 2005: 19). Currently, engineering educators are required to state the outcomes. Many engineering educators who were inflected by Bloom's Taxonomy of Educational Objectives for cognitive domain continued to use it in its original form (Haywood, 2005: 19). Bloom's (1956) six levels of cognitive learning which include “Knowledge” which refers to the remembering of previously learned material, “Comprehension” which refers to the ability to grasp the meaning of previously learned material, “Application” the ability to use the learned material in new and concrete situations, “Analysis” the ability to break down material into its component parts so that its organizational structure may be understood, “Synthesis” the ability to put parts together to form a new whole, and finally “Evaluation” the ability to judge the value of material for a given purpose. According to Haywood, there is little doubt that the so called “outcomes movement” has its origins in The Taxonomy of Educational Objectives.

2.3.2. Curriculum Design in Engineering Education

As it has been seen earlier in this study, curriculum is taken as the formal mechanism through which intended educational aims are achieved. Achievement in the sense of this research refers to the students’ construction of knowledge, skills, and attitudes based on their prior knowledge and are able to do what they are supposed to do. Curriculum incorporates the social, cultural and even political background of the program of a course. In the end, this formal mechanism includes two prime factors: instruction and learning and the issues of curriculum design have become a central paradigm in engineering education. Curriculum issues are inseparably linked to current thinking and action on educational concerns and reforms around the world. For instance, the imposition of General Agreement on Trade in Services (GATS) regime (Robertson, 2006) in the education sector necessitates enrichment and broadening of engineering curricula so that engineers will be better prepared to work in a changing global economy.

Accords & treaties like the Washington (1989), The Sydney Accord (2001), The Dublin Accord (2002), & The Bologna Process (1999) and others have been agreed upon to homogenize curriculum. Even though Ethiopia is not an official member of such groups at the moment and did not sign any of the treaties, it is obvious that it would be influenced by those ideas as long as curriculum development is backed financially by the government and technically supported by foreign advisors.

2.3.3. Teaching and Learning in Engineering Education

If engineers have to do what is expected of them properly and meet the demands of society in solving the problems it may have, they must learn the knowledge and acquire the skills that is required by the engineering profession. Without such proper knowledge and skill of engineering it is unlikely that problems that require engineering solution would be solved persistently in a way it assures sustainability. The acquisition of such knowledge and skill by the students, in part depends on what teachers offer to their students (Felder & Brent, 2005: 57). Even though this is a widely recognized view of the significance of the teacher within the process of teaching and learning, college teaching may be the only skilled profession that does not routinely provide training to its novice practitioners (Brent, & Felder, 2000). According to Brent and Felder, teachers:

> *had to teach themselves how to devise stimulating lectures and rigorous but fair assignments and tests, how to motivate students to want to learn and how to make them active participants in the learning process, and how to help them develop critical problem-solving, communication, and teamwork skills* (Brent &Felder, 2000).

It is believed that the best method of teaching in undergraduate level is induction (Felder, 2002) whether it is called problem-based learning, discovery learning, inquiry learning, or some variation on those themes. In these methods students are presented with a challenge and then learn what they need to know to address that challenge. The methods, however, differ in the nature and scope of the challenge and in the amount of guidance students receive from their instructor as they attempt to complete their tasks (Felder & Prince, 2007). In other words, in most cases, the traditional college teaching method is deduction, which starts with "fundamentals" and proceeds to applications. Many students prefer deductive presentation than inductive approach (Felder, 2002).

Hence, instructors who set out to implement an inductive method should therefore, first familiarize themselves with best practices in using these methods, such as providing adequate scaffolding—extensive support and guidance when students are first introduced to the methods and gradual withdrawal of support as students gain more experience and confidence in its use. They should also anticipate some student resistance to the method and be aware of effective strategies for defusing it. If these precautions are taken, both the students and the instructors should soon start seeing the positive outcomes promised by the research.

One of the approaches to problem based teaching is exposing students to industries in the form of internship. Some findings indicate that internships have fast become an integral component of many academic programs, offering benefits to all participating parties: students, schools and employers. For some engineering institutions elsewhere, internship programs are mandatory (Trotskovsky & Sabag, 2014). However, care must be taken in the design and implementation of such programs and evaluations should be conducted on a regular basis to ensure that the internship program and academic curricula are meeting industry demands.

Engineering education curricula, in the Ethiopian context also put internship as one of the important element for student learning. It is thought that the students' exposure to industry serves two major functions among others. The first and the most important is its use as means of introducing students to the real work situation. Secondly, it is also believed that it fills the skill gap students might have during their in-campus education. Since there is no meaningful research on how properly it is implemented and its impacts in general, much cannot be said about it.

2.3.3.1. Student's learning in Engineering Education

Interest in student centered education has become a phenomenon that attracts many of those who are involved in the business of education and teaching-learning of every level (Felder and Silverman, 1988; Murr, 1988; Waldron, 1986, Kolb, 1984, 1985; Spencer & Mehler, 2013). For instance, Kolb (1984, 1985) developed a two-dimensional circular or three-dimensional spiral model of how people learn (Felder and Silverman, 1988). The first of Kolb's model refers to active experimentation (AE) versus reflective observation (RO) that indicates to how individuals prefer to transform experience into knowledge. Individuals who favor active experimentation like to get things done and see results. Reflective observers prefer to examine ideas from several angles and to delay action. The second dimension in Kolb's theory refers to the dichotomy between abstract conceptualization (AC) and concrete experience (CE). This dimension distinguishes between how an individual grasps or takes in information. Abstract conceptualizers prefer logical analysis, abstract thinking, and systematic planning. Individuals who favor concrete experience want specific experiences and personal involvement, particularly with people, and tend to be nonsystematic.

Spencer and Mehler (2013) pointed out that the goal of science education should be to help students develop four aspects of scientific proficiency, the ability to (i) know, use, and interpret scientific explanations of the natural world; (ii) generate and evaluate scientific evidence and explanations; (iii) understand the nature and development of scientific knowledge; and (iv) participate productively in scientific practices and discourse (Spencer and Mehler, 2013: 25). According to these authors, such an approach to science teaching will require a shift from the teacher-centered instruction (which was the common practice in science classrooms in the past) to more student-centered methods of instruction. So, the defining feature of these instructional methods, as stipulated by Spencer and Mehler, is who is doing the sense-making. In the teacher-centered instruction the sense-making is accomplished by the teacher and transmitted to students through lecture, textbooks, and confirmatory activities in which each step is specified by the teacher. In these classrooms, the instructional goal is to help students know scientific explanations, which is only part of the first aspect of scientific proficiency. In student-centered instruction, the sense-making rests with the students, and the teacher acts as a facilitator to support the learning as students engage in scientific practices.

Wankat & Oreovicz (1993) associate the act of student learning with the "disequilibrium caused by new data which cannot be explained by the old model and which leaves the students with the inability to solve required problems with the help of their previous knowledge" (Wankat & Oreovicz, 1993: 284). According to these authors, student learning takes place within the individual and it takes place when the individual thinks it is new and useful and when they are incapable of solving problems with the knowledge and skill they know before. The usual lecture-homework sequence requires formal operations. For instance, students who are still in the concrete operational stage (Piaget,

1954) in physics have difficulty revising their knowledge structures. For those in this stage, the concrete operations of the laboratory can be instrumental in helping them accept the new organization of knowledge. The laboratory exercise has other advantages as well. In the laboratory the student must be active, unlike in a lecture where a passive approach is allowed and often encouraged. Reconstruction requires active mental effort by the student. The laboratory is also often a group activity which encourages students to discuss their understanding of physics actively, and the experience provides support from the group. The traditional model focuses on the delivery system and not on the learner. In the traditional view knowledge exists independent of the individual and the mind of the learner is a "tabula rasa", a blank tablet, upon which a picture of reality can be painted. In this model learning takes place if the student is attentive, when the teacher unloads his or her almost perfect picture of reality through well designed and well presented lectures. But on the contrary, the constructivist theory says the tablets are not initially blank and only the individual can do the writing.

The other crucial thing for student learning is motivation. Even though much of this motivation is beyond the teacher's control, he or she can do a great deal either to motivate or de-motivate students. Motivation is usually considered either intrinsic (internal) or extrinsic (externally controlled) and which includes many things that the instructor can do, including grading, providing encouragement and friendship, and so forth.

2.3.3.2. Assessment and Evaluation in Engineering

Olds, Moskal, and Miller (2005) defined the term assessment as an "act of collecting data or evidence that can be used to answer classroom, curricular, or research questions" (Olds, Moskal, and Miller 2005: 23). These authors, in addition, define what an assessment method is. An assessment method, according to Olds, et al. (2005), refers to the procedures used to support the collection of data for assessment purposes. The starting point for reaching to an effective assessment results is having clear goals (Angelo & Cross, 1993). It requires answering questions related to what is most important to teach and what students should really learn. According to Angelo & Cross (1993), there are different techniques of assessment which are related to the assessment of course-related knowledge and skills, skill in analysis and critical thinking, skill in synthesis and creative thinking, skill in problem solving, skill in application and performance, learner attitudes, values, and self-awareness, and learner reactions to class activities. Angelo & Cross base their model of classroom assessment on seven assumptions of the following:

- *The quality of student learning is directly, although not exclusively, related to the quality of teaching. Therefore, one of the most promising ways to improve learning is to improve teaching;*
- *To improve their effectiveness, teachers need first to make their goals and objectives explicit and then get specific, comprehensible feedback on the extent to which they are achieving those goals and objectives;*
- *To improve their learning, students need to receive appropriate and focused feedback rarely and often; they also need to learn how assess their own learning;*
- *The type of assessment most likely to improve teaching and learning is that conducted by faculty to answer questions they themselves have formulated in response to issues or problem in their own teaching.*
- *Systematic inquiry and intellectual challenge are powerful courses of motivation, growth, and renewal for college teachers, and classroom assessment can provide such challenge;*
- *Classroom assessment does not require specialized training, it can be carried out by dedicated teachers from all disciplines;*
- *By collaborating with colleagues and actively involving students in classroom Assessment efforts, faculty (and students) enhances learning and personal satisfaction* (Angelo & Cross, 1993).

1.5. The Development of Education in Ethiopia: A Milieu for Engineering Curriculum Development Process

Richard Hooper (1972: 2) indicates “at a time of controversy, ‘tradition’ is quoted as a defense against change. An important way of setting the context within which curriculum can be studied is to analyze ‘tradition”, in this quotation Hopper calls for the attention of those who are involved in the study of curriculum, that they need to be concerned and analyze the inherited, established, or customary pattern of thought, action, or behavior to understand the present. This researcher thinks that this has to do well in the case of the Ethiopian education and curriculum development systems because he believes that the starting point for the Ethiopian education system is not the introduction of the western type modern education. Any curriculum research undertaking that neglects the previous experiences (which may be strong or weak) and focuses solely on the present, somehow misses some important elements that connect the past with the present or that may be drawn from the past. It is believed that “curriculum is socially and historically located and culturally determined (Hooper, 1971:2). The study of any curriculum development and practical undertaking does not develop in a vacuum but proceeds based on beliefs— seldom made explicit about how people learn what human beings should be like, and what society is.

To begin with, it is a well-recognized fact that Ethiopia has a long history of education, teaching and learning, and assessment (Amare, 2005; Alemayehu & Lasser, 2012). The very existence of what we call education and its process, be it traditional, elementary, secondary, tertiary, or engineering, physics, chemistry, and others, is not a onetime development process and activity. It is a dynamic process, that grows and develops through time and nested within the culture of society and regenerate itself continuously from time to time as the society and its culture grows and changes. The beliefs that gave rise to the very existence of the education system in Ethiopia in general, and modern education in particular, and the process by which it was made to exist and develop together form the milieu of education in Ethiopia including engineering education. Hence, a brief look to the past evolvement of education in Ethiopia and its process may give us an opportunity to pick some elements that may facilitate or hinder our present action in our general or specialized education system and act upon it in accordance.

Ethiopia is a country located in North Eastern part of Africa. Its surface area covers a total of 1.125 square kilometer. Its climate varies from temperate in the highlands to tropical in the lowlands. Ethiopia is the second most populous country in Africa (World Bank indicators, 2010) next to Nigeria comprising a total population of 82.95 million. Of these, 48,561,390 are in the school age range of year 4 to 21 (Calculated from MoE (2010) Education Statistics Annual Abstract, 2002 E.C.). Of the total school age group, 28,750,782 are males and 19,810,608 are females. Different nations and nationalities residing within the country’s territory are the core for the county’s political, economic, and social structures that identify the country as the Federal Democratic Republic of Ethiopia. Ethiopia had its own education system, that served the Ethiopian Orthodox Church and the elite groups affiliated to it and which is different from the western type of modern education, even long before the introduction of modern education (Amare, 2005; Solomon, 2008).

Though the western culture of the natural and applied sciences seems to shape and be the dominant influence of the present modern education system in Ethiopia, it cannot be said that the western culture of education is the only influence that shapes the Ethiopian education system as a whole. This means even professional education such as engineering education and others, as part of the whole system are influenced by the influences that shaped the whole system of education. Anyhow, the intention in this part of the study is not to give an in-depth account of this line of argument; it is, just to indicate that the Ethiopian education system is influenced not only by the western culture of education but also by the Ethiopian culture of education.

2.4.1. Traditional Education

As it is mentioned herein above, the aim in this section of the study is not to give a detailed account and analysis of the traditional education. Rather, it is to give a brief highlight of the development of the Ethiopian education system and the practices of curriculum development evolved through time with the assumption of connecting the past with the present in terms of the concept of education, curriculum, curriculum development, and its implementation.

Scholars in the field of education inform us that Ethiopia has a long history of traditional education that began and subsequently developed under the realm of religion. It existed mainly as church education or as Koranic education. Though there were some evidences of what was included, in these type of education (Amare, 2005), the details of how it was organized, the bases for its content selection and sequencing, and the like seems to be less known and require more research. Nevertheless, Ethiopia "has had its own indigenous education and curriculum" (Solomon, 2008: 34; Amare, 2005) prior to the introduction of the western type of modern education and its influences are still visible in the education system in many respects.

2.4.2. The Development of the Ethiopian Modern Education

Many scholars, in one way or another, have dealt with the history, nature, and characteristics of the Ethiopian education. (Maaza Bekele, 1962; Girma Amare, 1967; Pankhurst, R. 1974; Teshome G. Wagaw, 1979; Amare Asgedom, 1995 and Tekeste Negash, 1996) are among many others in this regard. This, by no means, is not to claim for exhaustiveness. Ethiopia has a long history of education in general, and a form of education of different types and different levels peculiar to its own. The nature and the history of higher education, as related to Ethiopia are documented in Amare (2005). The concept and practice of structured traditional and formal education was well developed in certain parts of the country even before the introduction of the European type of education (Amare, 2005). In spite of this fact, indigenous education by large still remains to be an important transmitter of cultural identity from one generation to the next among many ethnic and linguistic groups (Derebssa, 2006: 62; World Bank, 2013). Formalized education in its traditional form, though not accessible for the large number of Ethiopians, existed since the fourth century A.D., and survived as a means for transmitting the long lived Christian and Islamic religious cultures and skills associated with them until the end of the19th century. Since the beginning of the sixth century, the Ethiopian Orthodox Church had maintained a highly structured organized system of education. The Islamic religious education also existed and developed probably starting from the 7th century (Amare 2005). The education, especially the church education, provided throughout those earlier days, was mainly elite education (Saint, 2004; Teklehaimanot, 1999) which was linked to the Orthodox Church and it was meant to serve the functions associated with Christian religious tasks. Likewise, the Koranic schools that were attached to and promoted by the centers of Islamic faith used to have a parallel function in spreading the reading and writing of Arabic, the study of Islamic philosophy and law and the teaching of the Koran (Amare, 2005).

Even though practical and accumulated wisdom and experiences were passed from generation to generation through the formal religious institutions mentioned herein above in certain limited parts of the country, in many of the social groups of Ethiopia the traditional/indigenous education process was also institutionalized in an age - grade system that ensured the continuity of experience and organization.

The process in the introduction of programs and structures of teaching and learning that differed fundamentally from the traditional, religious based system was not really officially initiated until the very end of the nineteenth century. At the beginning of the twentieth century, the establishment and growing of urban seat of power or “the need to preserve a modernized centralized power” (Mekasha, 2005; Alemayehu & Lasser, 2012), and other factors, such as the arrival of foreign embassies and the beginnings of new features of commerce and manufacturing, combined together prompted and necessitated the beginning and promotion of a different pattern of education (Tekeste, 1996: 13).

The provision of modern education in Ethiopia officially began in the year 1908 with the opening of Minilik II School in Addis Ababa, marking a significant step in the history of education in the country. It had been followed with the additions of more schools soon after. The content of the curriculum, within the new school system included Amharic, Geez, Arabic, Italian, French and English (MoE, 1984). Simply by looking into such provision of education, it would not be difficult to understand what the emphasis of education was and what was needed by educating youngsters. The emphasis on language teaching clearly entails that the need was on communication skills. But here one could raise a mega question ‘whose need was served by such curricula? And who steered the initiative to produce the curricula?’ This researcher believes that the system established at that point in time had set the Ethiopian education context which still has an impact on our current education system in many ways. Such question might have been addressed by researchers in the field, if not, or as complementary note, this researcher would like to suggest the importance of conducting research that involves parents, students and the wider public with regard to the kind of education they need. How do parents judge the quality of a school these days in Ethiopia? And how do these parents judge their children’s education and pay more money for it in the form of tuition fee? How do private schools attract students? Do the private schools attract students by emphasizing on language or on the sciences? In raising questions such as these ones and trying to find out answers, one may be able to come up with the knowledge of the impact of the earlier thinking of curricula to the present school system we have today.

The introduction of the Western (modern) education, from the outset, did not please a number of people and was not welcomed by the Ethiopian Orthodox authorities and their followers and inflicted resistance to it. Hence, the attempt of bringing change through the traditional models to modern and secular form of education, however, was not a simple task for those who tried to change (Alemayehu & Lasser, 2012: 53). After a serious conflict with the church authorities and their followers, an agreement was reached in 1907 to employ teachers of the Coptic faith to teach in the new system of education.

Its objective was to provide education that would equip the students who could serve the state in different sectors of the economy and other service areas at different levels and capacities. The need for having more contact with the outside world also became one of the significant stimulants for education and encouraged the introduction and use of the schools as a means for the creation of high level interpreters and translators. In those early days, the content of the education provided within the schools focused mainly on communication skills and the essentials that were necessary to run the then new bureaucracy and the associated institutions.

For the first time in Ethiopian history, a director general of public education was appointed in 1929 and it was elevated to the status of Minister in 1930. At that point in time there was no physical system capable of supporting the systematic growth of educational services. The system remained dependent on personal funds in spite of a decree in 1930 allocating a 2% of tax revenue to education. However, the idea of centralization and control, in short, the formulation of an education system in its modern form began and continued slowly to take shape. Committees were organized to plan and shape the system to meet the growing needs of the community for education (year book, 1951-53). Up to 1945 it was a period of increasing the number of elementary schools. At that time parents also began to realize the importance of public education and students were no more asked to come to school as it were in the years before then (year book, 1951-53).

The first high school, the Hailesellasie I Secondary School, was formally inaugurated in 1943 and teachers who would teach at that level were provided by the British Council (Trudeau, 1968). During that time, there were many teachers teaching in the elementary schools and almost all of them were foreign teachers. Evidences reveal that there were no definite programs of studies in the education system at that time, but secondary schools were better unified because they were preparing students for the school-leaving certificate along the general lines of the London Matriculation (Trudeau, 1968). In 1952 there was a relatively strong network of the then existing four hundred elementary schools and three colleges.

In the years 1951 - 53 there were six secondary schools. The curriculum for this level was adopted by the Ministry of Education in the year 1951-52, and it became operational in all of the secondary schools. Entrance to the secondary schools was based on the elementary school leaving examination. The courses provided at the secondary level were primarily for academic preparation of youngsters for the London Matriculation, which was later changed to General Certificate of Education. Students who were successful in the London Matriculation or the General Certificate of Education either went abroad for higher education (in the earlier years) or continued at the University College of Addis Ababa, which was established in 1950. Seen in general, the education provided in the country from 1940s until the end of the 1960s, as observed by Tekeste (1996: 15) "could be described as an elitist system".

In 1955 there was a structured government school system that comprised three main divisions of elementary – covering grades one to eight, secondary – covering grades nine to twelve, and higher level. At about the same time thoughts of "Long – term Planning" (MoE, 1955) appeared in the Ethiopian education system accompanied with the establishment of the Long-Term Planning Committee that comprised four Ethiopians and seven foreigners. The committee was authorized to undertake a survey of the then existing system, the schemes of work and academic standards and to make recommendations for possible reorganization (The Long-Term Planning Committee, 1955 (1947 E.C.)). This committee was also authorized to call for written and personal reports from administrators, school directors, teachers, and others engaged in or concerned for Ethiopian education.

The Long-Term Planning Committee's first report, which was entitled "Basic Recommendations for the Reorganization and Development of Education in Ethiopia", was presented in 1954. In that report, the committee, proposed the idea of "Community Schools for Basic Education", with the assumption of achieving the "modest possible distribution of opportunity for learning". The community schools were thought to provide basic education in its four year program to every individual within the empire. Command of the Amharic language and other basic abilities were intended to be provided at the community school level. It was also thought that the education provided at that level would enable individuals to cope more efficiently with the problems of everyday living and they would also contribute towards the advancement of the community and the country. In addition to this, it was also envisaged that a certain portion of selected community school graduates would be admitted into the four-year middle school program and that upon the completion of the middle school program a further selection would be made for entrance to the different type of secondary or higher schools. Even though the committee then was aware (as it claimed in one of its reports) of the necessity of providing education beyond the community school level to every child, at the same time members of the committee were convinced that it would not be possible to provide education for all beyond the community school level and that selective procedure would have to be applied at each further stage of the school system. The committee's report, also added a recommendation for the immediate reorganization of the system by the designation of the first four grades as "Primary", and the next four grades, that is, grades five through eight, as "Middle Schools" and the system of selection had to be retained in those school systems at each level.

The Board of Education, to whom the report was presented, after having looked into it and proposed certain amendments, returned the report to the committee. The committee then readily accepted the amendments and included in the final version of the report. Finally the board informed the committee that it was prepared to accept in principle the revised recommendation. At the same time the committee was also informed and authorized to consider the details of the organization, curriculum, and staffing with a view of implementation. While the agenda and the view on the provision of primary and secondary education were predominantly on a restrictive and limiting position, and while it was still in a fluid state, paradoxically, the need for considering the establishment and development of higher education started to come into sight.

2.4.3. Higher Education

The provision and practice of modern higher education in Ethiopia is relatively young, compared to the actual beginning of western type modern education within the country. On top of the long existed traditional education and the then yet developing primary and secondary education, Ethiopia also introduced higher education and began teaching students at that level in 1950 (AAU, 2008; Amare, 2005). Though there were many Ethiopians who went abroad (Amare, 2005) before the year 1950 there was no evidence of any Ethiopian (at least to knowledge of this researcher) who actively and decisively played a significant and knowledge based contribution for the establishment and materialization of higher education system in Ethiopia.

Because of the felt need for higher education from the government side, the establishment of higher education was decided by the Ministry of Education of Ethiopia from the outset (Trudeau, 1964). As a response to the Emperor’s demand for a kind of policy he should follow in establishing the secondary and vocational sections of Tefari Mekonene School, Dr. Matte proposed for the establishment of higher education (Trudeau, 1964). Mattee suggested the development of a university that comprised Engineering (Civil, Mechanical, Mining), Agriculture, Science, Botany, Geology, Mineralogy and Geography. Mattee also suggested the opening of medical school in conjunction with that of the school of sciences. Hence, a committee on founding of higher education was set in 1949 and this committee, within the same year, recommended the creation of a four year liberal arts college leading to B.Sc. and B.A and comprising two faculties—the Faculty of Science and Faculty of Arts. On the bases of the recommendation, the college was established in 1950 and was named as Trinity College which later, after eight months, changed to Addis Ababa University College (AAUC). Matte was appointed as the founding president of the first higher education institution. The faculty of Science was considered as the most important and was made to offer courses in Agriculture, Mathematics, Physics, Chemistry, and Biology. On the other hand, the Faculty of Arts was made to offer courses in Administration, Education, and Social Sciences.

As there were no Ethiopians who were capable of teaching at that level and at that time, Jesuit teachers of various nationalities who were initially involved in the teaching of secondary students at Teferi Mekonnen School (now Entoto Technical and Vocational College), were appointed to teach in the newly established University College. The first classes of higher education were begun on December 11, 1950 and this marked the first landscape for the start of the Ethiopian higher education in Ethiopia.

Even though the distinction between them was not flagrantly supported with an in-depth and comprehensive study, the Ethiopian higher education system had gone through "three major changes" (Wuhibegezer, 2013: 45). The first of the changes, was "the phase of an elitist education system under the traditional monarchy", the second phase was the change that was imposed by the "military rule where ideological control penetrated into the education system" and the third one was the higher education system "under FDRE" (Wuhibegezer, 2013: 45) where expansion of higher education become too evident. These changes were mainly associated with government changes. It is true that these changes have been major externally proposed changes that influenced the higher education system in many ways. But these alone do not suffice to be the only measures for the changes in higher education. Of course, that is, what is better known than any other changes that might have taken place within the higher education institutions. If we push the quest a little further and ask questions like: is the present higher education significantly different from the elitist education that was phased out? The answer we may get could probably be one of discouragement.

2.4.3.1. The Curriculum of Higher Education

In the preceding part it has been pointed out that the Ethiopian higher education system was established in 1950 which means 65 years back. Mention has also been made that the higher education at the beginning was influenced by the North American concept of Liberal Arts College. The curricular content was a Liberal Arts type similar to that of Jesuit College of North America. Liberal Arts and Sciences as defined by the State Education Department/the University of the State of New York (2003) refers to "courses of a general or theoretical nature that are designed to develop judgment and understanding about human beings' relationship to the social, cultural and natural facet of their total environment". This may be regarded as a landmark for laying down one of the foundations that characterizes the Ethiopian higher education curriculum. As it has been indicated earlier in this study the Ethiopian higher education system has undergone three changes associated with government changes. Though these changes witness the changes in the education system in general, research in higher education seem to be limited and fail to address the detailed changes that might have taken in the perspectives and ideologies that shaped curriculum and curriculum development in the realm of higher education.

2.4.5. Engineering Education

The provision of engineering education had started and existed within the Ethiopian education system since the year 1953 and it was administered by the Ministry of Education of Ethiopia at the beginning, for some years (Faculty of Technology, (1979-80 G.C.; Addis Ababa University Golden Jubilee 1950-2000, Agenda). The first classes of engineering were started and continued in what was called engineering college which was situated within the compound of the Technical School of Addis Ababa up to the year 1965. The first two years of its beginning was devoted to provide a two year intermediate engineering studies which prepared students for the completion of a degree level study abroad. Soon after, in 1955 a four-year degree program was commenced and upon completion of the program the first B.Sc. degrees were awarded in civil and industrial engineering in 1958.

However, in 1959 industrial engineering was made to phase out, and on the other side, expansion took place by the inclusion of electrical and mechanical engineering on the then existing programs. The consolidation of the Building College, (which was formerly known as the Ethio-Swedish institute of Technology) in 1961 was another side of the expansion of engineering education in Ethiopia. The Ethio-Swedish Institute of Technology was established in 1955 and initially it used to have a Diploma program in Building Technology which continued until it was finally changed and upgraded in 1957 to four-year degree program. The duration of the study of the engineering programs was four years and prolonged to five years on the grounds of shortages in qualified staff and the inadequacy of laboratories. But later in 1978 it was again changed to four years. Although much was not known about how the content was selected, the specific structure of the curriculum and the details of the practices (at least to the knowledge of this researcher), efforts were also made to overhaul the curricula of all the programs. Along with the overhauling of all the programs, the five-year engineering programs were again changed to a four-year program and the three-year advanced diploma program of Building Technology to two-and-half years.

Moreover, the provision of engineering education was extended to the relatively new institutions such as Arba Minch Water Technology Institute, which was originally established in 1986 under Water Resource Commission, and which was later transferred to the Ministry of education, Jima University, Makalle University, Bahir Dar University, and Hawassa University.

Currently, engineering education is provided in a number of engineering education institutions and universities within Ethiopia guided by the ECBP reform initiatives that took place since the year 2005. The general goal of the ECBP was, “improving the competitiveness of local manufacturing and construction industries and creation of employment opportunities for Ethiopian youth and thereby improving the standard of living of the society" (Bayou et al. 2006: 18). The university specific goal which was regarded as one of the strategies of attaining the ECBP's general goal was "improving studies in technical and managerial fields including the studies and training of vocational school teachers" Bayou, et al 2006: 18). This was further detailed to include the following specific objectives.

- *Develop and implement proposals for re-organization of university structure in order to acquire more decentralized, effective and cost conscious administration;*
- *Prepare and implement professional profiles for Architecture, Construction management, Urban and Regional Planning, Civil Engineering, Chemical Engineers, Electrical and Computer Engineers, Mechanical Engineers and revise and implement graduate and post graduate programs.*
- *Conduct human resource development in line with new curriculum.*
- *Establish partnership between Ethiopian and foreign universities/departments for all kinds of cooperation.*
- *Establish and strengthen University-Industry linkage promotion.*
- *Prepare and implement infrastructure upgrading requirements of university facilities for selected universities/departments.*
- *Establish a system of E-learning and develop and implement a concept for IT-based library and build models.*
- *Develop and implement comprehensive practice oriented concept of TVET Teacher Studies and a demand-driven HRD scheme* (Bayou, et al. 2006, 18-19).

The specific goal of the ECBP's university reform was to acquire a practice and demand oriented higher education in the wider field of engineering disciplines that can actively and innovatively contribute and support the industrial development of Ethiopia. This model, as it is pointed out in Chapter one of this dissertation, is closely associated with human resource development that has to do with improving working systems that would help the industry and the manufacturing sectors within the country.

CHAPTER THREE

THE RESEARCH METHODOLOGY

3.1. Introduction

This study employed a qualitative case study methodology that involves three higher education institutions for the study of the curriculum development process of engineering education program and its practices within the higher education context. The chapter deals with the description and explanation of the research methodology and the design employed to undertake this particular study.

3.2. Qualitative Research Approach: A Choice for this Study

The focus in this study was on understanding of the new engineering curriculum development process and its practices from the perspectives of stakeholders within three purposely selected engineering education institutions in Ethiopia. Generally, researchers in engineering education appear to favor more of quantitative methods due to their training background, which resides within the post-positivist perspective (Borrego, Douglas, and Amelink, 2009: 53). However, qualitative research, in recent years, has gained more importance and used in engineering education research as engineering educators try to improve classrooms, programs, and institutions (Leydens, et.al., 2004: 65; Koro-Ljungberg & Douglas, 2008: 163; Case & Light, 2011: 188; Chism, et. al., 2008).

An "understanding of the engineering curriculum development process and its practices", in this particular study, refers to gaining a better insight into the processes and the decisions that are involved in the engineering curriculum development and its practices and it includes the strengths and/or weaknesses, and encounters of engineering curriculum development, and factors affecting positively or negatively in its development process and its practical implementations at each level, as seen from the perspectives of stakeholders, within the engineering education system in Ethiopia, with a particular reference of the three sites involved in the study.

Qualitative research approach is chosen as a methodology for this research for its power in an in-depth treatment of the research problem. Qualitative research is defined as "primarily an inductive process of organizing data into categories and identifying patterns (relationships among categories)" (McMillan and Schumacher, 1993: 479). Casewell (1998) sees qualitative research as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem". According to Casewell, such a research builds complex and holistic pictures, analyzes words, allows a detailed view of information, and it is conducted in a natural setting. Similarly, Dinzen & Lincoln (1994) express the power of qualitative research as follows:

> *Qualitative research is a situated activity that locates the observer in the world. It consists a set of interpretive material practices that make the world visible. These practices transform the world. They turn the world into a series of representation, including field notes, interviews, conversations, photographs, recordings, and memos to the self* (Denizen & Lincoln, 1994).

On the other hand, Strauss and Corbin (1998) define qualitative research in terms of its properties by saying:

> *By the term 'qualitative research' we mean any type of research that produces findings not arrived at by statistical procedures or other means of quantification. (Strauss and Corbin, 1998: in Ritchie and Lewis* (2003:3).

Therefore, this researcher believes that qualitative research is more suitable for an in-depth investigation of the answer for the research questions raised in this study and to attain the objectives set, by probing data from those who are directly or indirectly involved in the engineering curriculum development process and those who are currently experiencing it at institution level.

3.2.1. Why Multiple-case Study (Embedded) Design?

Qualitative study in general is an approach to research that facilitates exploration of phenomenon within its context using a variety of data sources. Yin (1994) defines case study as an empirical investigation into the contemporary phenomenon operating in a real-life context. It is argued that case study research is heterogeneous activity covering a range of research methods and techniques, a range of coverage, differing lengths and levels of involvement in organizational functioning and a range of different types of data (Hartley, 1994).

The focus of the study, that is, "engineering curriculum development process and its practices" is the main case of the study having different sub-cases within it. The different research sites into which the engineering curriculum is practiced are multiple cases entertaining the same case, that is, engineering curriculum development and its practice. Schramm (1971) points that "the essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result" (Schramm, 1971: cited in Yin, 1993: 12). Yin also posits that case studies in evaluation research have "at least five different applications" (Yin, 2003: 15). According to Yin, the first of these applications refers to explanation of the presumed causal links in real life interventions while the second aim is to describe an intervention in the real life context in which it occurs. The third applies to illustrate certain topics within an evaluation in descriptive mode; the fourth application is used to explore those situations in which the intervention being evaluated has no clear, simple set of outcomes; finally, the fifth type of application deals with a meta-evaluation—a study of an evaluation study.

Case study, in spite of its emphasis on the significance of knowledge generated in particular contexts (Case & Light, 2011), is also identified as one of the "emerging" methodologies in engineering education. The use of qualitative methods in engineering education, is recognized as a method that provides important insights which otherwise would have not been possible through quantitative approaches (Koro-Ljungberg & Douglas, 2008: 172). Rigorous qualitative case study permits researchers to have opportunities to explore or to describe phenomena in context using a variety of data sources. It allows the researcher to explore individuals or organizations (Baxter & Jack, 2008). The choice between a case study designs, however, falls between choosing a single-case design and multiple-case design (Yin, 2003). According to Yin, single-case designs are "justifiable under the following conditions" that is, when the case represents a) critical test of theory, b) rare circumstance, c) a typical case, d) revelatory or (e) longitudinal purpose.

On the other hand, the evidence from multiple cases is regarded as "compelling" and "robust" compared to that of the evidence from a single-case design. It also addresses the question related to the researches' "replication" purpose. A multiple case study enables the researcher to explore differences within and between cases. According to Yin (2003), case study designs can be single-case (holistic) designs (Type 1), single-case (embedded) designs (Type 2), multiple-case (holistic) designs (Type 3), and multiple-case (embedded) designs (Type 4) (Yin, 2003: 39).

Hence the case study design employed in this study is influenced by the multiple-case (embeded design) (Yin 2003). Engineering curriculum development process and its practices involves different tasks such as that of curriculum planning, implementation (teaching and learning), and student assessment. These are cases (embedded) within the main case study of the engineering curriculum development process. On the other hand, since the same research is conducted within three different sites by employing similar strategies of data collection and analysis, it can be labeled as a multiple case (embedded) design or as indicated by Yin (2003) Type 4 design. Yin points out that the evidence from multiple case studies is more compelling and the overall study is therefore regarded as being more robust.

The "two mainly known approaches", which guide case study methodology, are that of Stake (1995) and Yin (2003) (Baxter & Jack, 2008: 545). Baxter & Jack (2008) point out that both Stake and Yin base their approach to case study on a constructivist paradigm, which claims that truth is relative and that it is dependent on one's perspective. The constructivist paradigm "recognizes the importance of the subjective human creation of meaning, but doesn't reject outright some notion of objectivity" (Baxter & Jack 2008: 545).

Given that there is little or no empirical research in engineering curriculum development and its practices in the context of Ethiopia, the present research can be regarded as exploratory in its nature. Case studies help achieve this purpose by using a manageable sample to gain deep understanding of each case. Lastly, literature has suggested that the perception with regard to the concept of curriculum, curriculum development and its practices vary. Multi-case studies better capture the conceptual and practical variability of curriculum and the teaching learning experiences of teachers and students within the different sites than single case studies and "enhance the generalizability of the research findings" (Yin, 2009).

Stake (1995) categorizes case studies into two types: intrinsic and instrumental. An intrinsic case study focuses on learning from the case, and an instrumental case study focuses on learning about the issue, or research questions (Stake, 1995, p. 24). The current research also falls into the instrumental category which means that this researcher used the cases as instruments to understand the issue of engineering curriculum development process and its practices and how teachers and students experienced and made sense of their experiences.

3.2.2. Data Sources and Strategies of Data Collection

To serve as a guide, the present researcher has constructed the following framework and has used it as a guide to indicate the directions and the interrelationship of the different aspects or activities of the research undertaking which include the research questions, data collection methods, data organization/management, analysis of the data, and the findings of the study and their implications to engineering curriculum development and its practices. However, the figure does not show the details of what is included and what happened in each of the boxes. Those are described separately one by one in the subsequent parts.

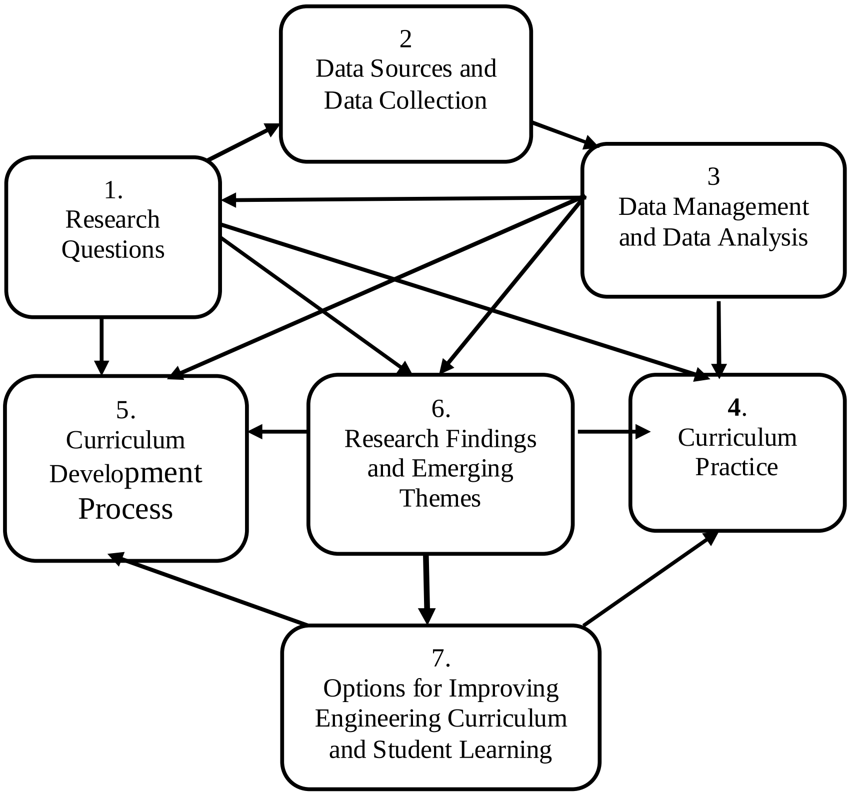


Figure 3. Data Collection and Processing Framework

The direction of the arrows, as can be seen above, indicate how the activities are interconnected. For instance, the arrows which start from the box that contains "research question" (Box 1) are directed towards Box 2 indicating that data sources and data collection techniques are made and used in reference to the research questions. The three arrows pointing to Boxes No. 4, 5, and 6 indicate that the research questions are about the understanding of the curriculum development process (Box 5) and its practices (Box 4) which, at that point, was expected to result in findings and emerging themes (Box 6). The arrow that begins from Box 2 and points to Box 3 indicates that the data collected from all sources can be managed and analyzed to answer all the research questions (box 1) with regard to the curriculum development process (Box 5) and its practices (Box 4) and finally to the research findings and the emerging themes (Box 6). The two arrows that begin from Box 6, pointing horizontally to Boxes 4 and 5 show that the findings and the emerging themes mainly speak about the engineering curriculum development process (Box 5) and its practices (Box 4). The arrow that starts from Box 6 and points towards

Box 7 shows the contribution of the findings and the ideas of the emerging themes to the conclusions, suggestions and/or recommendations.

3.3. Procedures for Selecting the sites and Participants for the Study

The initial phase of data collection involved the decision about which sites to select and whom to involve in the interview and/or in focus group discussions. This was a very crucial stage of determining whose ideas, perceptions, experiences, and attitudes will be most important to answer the research questions and to achieve the research objectives. Finally, the decision was made as per the criteria described below.

3.3.1. Site Selection

The three higher education engineering institutions, namely, Addis Ababa Institute of Technology (AAIT), the School of Engineering (SoE) at Adama Science and Technology University (ASTU), and Bahir Dar Institute of Technology (BIT), were deliberately selected as sites for the study on the anticipation of availability of sufficient number and appropriate participants for the study within these institutions. Though the three institutions share some common culture of higher education at present, they are also different in some respects. It is generally believed that each school has its own unique culture (Altrichter & Elliott, 2000), and specific cultures are molded by the shared experiences of participants. The three purposely selected sites are more or less, similar in their current official mandate since they all are obliged to enforce their activities on the basis of the education policy (1994) and on the higher education proclamation 650/2009. Even though they are different in their previous experiences of providing engineering education, at present they all stick to using the reformed engineering education curriculum which was developed under the auspices of the former ECBP and are expected to make progress in that provision. Nevertheless, they are different in their geographic location, historical background, experiences in providing engineering education, the number and the level of qualification of their teaching staff, and the physical and other resources under their disposal.

For instance, the SoE at Adama University and BIT, are somewhat younger in terms of the length of the time they have existed as engineering education institutions and in terms of their experiences in providing engineering education. On the other hand, AAIT has a rich and long experience of providing engineering education which extends back to the late 1950s. However, at present they all are involved in providing the undergraduate engineering courses in different fields of studies based on the ideas of the reformed engineering education framework, which was initiated by the Engineering Capacity Building Program (ECBP). To obtain reliable data regarding the topic under study and to have a better understanding of it, it was necessary to involve purposely selected participants from each of the selected sites. Initially, it was planned to collect data from four sites including Makelle Institute of Technology. Due to some time and resource constraints, data collection and site visits were limited to the three engineering institutions, that is, SoE of ASTU, AAIT, and BIT.

3.3.2. Selection of Individual and Group Participants

Although there are many actors in engineering curriculum development process and its practices, given the aim of the research, capturing the ideas of all stakeholders was beyond the scope of this research. Since no one is equal with teachers and students in terms of propinquity to the engineering curriculum, curriculum development process and its practices, primary focus was given to engineering teachers and students to serve as crucial participants of this research.

Teachers are the ones who implement the curriculum and students are the ones who are expected to be affected by the curriculum to result in the desired outcomes. Hence, teachers and students who were purposely drawn from the three sites of higher education/engineering institutions were made to be involved in the interviews and focus group discussions. However, data were also collected from purposely selected representatives of industry and key informants from the Ministry of Education (MoE), for their previous and present knowledge, acquaintance and proximity to the subject being studied.

The details of the sample selected are as follows: Selected teachers, who are teaching Mechanical, Civil, and Electrical Engineering courses in all the three institutions are included as participants in this study. Focus on teachers of these engineering areas was made because they existed as separate fields of studies within the engineering education system and are available within the three institutions selected for this study. Two teachers of each of the fields of studies who are believed to have better experience and ability of sharing their lived experiences in the engineering curriculum development process and in implementing the reformed curriculum were selected using purposive sampling method along with snowball sampling method.

Access to the participants was made through the deans of the respective institutions upon delivering a letter from College of Education and Behavioral Sciences particularly the Department of Curriculum and Teachers Professional Development, Addis Ababa University (see Appendix). Deans and department heads were also the participants of this research because of their proximity to the curriculum development process and their involvement in its practices within their respective institutions both in teaching and leading. They provided their perceptions and views during the interview sessions particularly planned for them and held in their respective offices.

Secondly, with the aim of triangulating the data obtained from teachers and other sources with that of the views of students, data were collected from purposely selected students of each of the three sites. A minimum of six student participants who were learning in their third, fourth, and fifth year of the different fields of engineering were purposely selected and were requested to participate in a focus group discussion set by this researcher in their respective institutions. They were selected from Mechanical, Civil, and Electrical fields of studies. These students were assumed to have been more acquainted with the curriculum, know what is happening in the teaching learning and assessment process, and they are more mature and experienced in the campus life in which they were learning.

Table 3. Composition of the Research Participants

Participants	Adama	AAiT	BiT	MoE	Industry	Total
MoE Experts	-	-	-	2	-	2
Deans	1	1	1	-		3
Head of Depts.	3	2	3	-	-	7
Teachers	6	6	5	-	-	17
Students	6	6	6	-	-	18
Industry key informants	-	-	-		4	4
Total	15	15	15	2	4	51

3.3.3. Procedure and Strategies of Data Collection

Data pertaining to the research questions and objectives were collected from different sources using different data collecting strategies. Primary data were collected using semi-structured interviews (see Appendix B) in the form of guided conversation and focus group discussion. Secondary data were obtained from written and recorded documents that included policy materials, curricular documents, examination papers, brochures, catalogues, agendas, and minutes of meetings.

3.3.3.1. Preparation for Data Collection

For conducting the research within the selected higher education institutions, primarily, a letter of request was secured from Addis Ababa University, College of Education, particularly from the Department of Curriculum and Teacher Education (see Appendix 1). At the initial stage of the contact with personnel in the research sites, a copy of the letter was delivered to Academic Vice President of one of the research sites, a scientific director of the second site, and to a deputy scientific director of the third site. Likewise, in the case of the first contact of three purposely selected industries, the same copy of the letter was delivered to the appropriate offices (e.g., public relation office, human resource development office) of each of the industries. Three industries, which the researcher thought that they are the most significant employers/consumers of engineers, were contacted with the anticipation of interviewing a key informant in each of the industries. From here the letter was forwarded to the persons who were considered to be knowledgeable on the subject of the study by the officer in charge (see, for example Appendix B). Vice president and directors of the academic institutions were contacted at the initial stage of data collection within the sites because they are the highest administrative officials responsible for the academic matters within those institutions.

After the researcher introduced himself and explained why he was there and what he needed, the officials signed and forwarded the same letter that carried a short memo, their signature, the names of the deans with whom the researcher should contact and the institution's stamp on it to the deans (see Appendix C). A photocopy of the signed letter was again delivered to each of the deans. As the researcher delivered the letters to the respective deans, he also introduced himself and briefly explained about the title and purpose of his research and he ultimately told to each of them that he needed to conduct interview with them, with teachers and focus group discussion with students. All of the deans, except one, whom the researcher contacted, were willing to be interviewed. Table 3 shows that one dean for each of the institution that included a vise dean whom this researcher substituted in place of the dean who declined.

Selection of the appropriate teacher and student participants was began and continued with the advice of the deans. In some cases they identified for the researcher the appropriate person whom they thought knowledgeable on engineering curriculum development and who had more experience in practicing it. In other cases they directed the researcher to the department heads for carrying on the selection of the participants. The department heads, as the deans did, also identified the names of more candidates for the interview. Having secured the names of the possible "would be" candidate interviewee (teachers), the researcher went to each teacher's offices to ask for their permission and willingness for the interview. Many of them responded positively to his request, soon after he introduced himself and he briefly explained the title and the purpose of his research to them. Only one declined the researcher's request on the grounds of being busy and not having enough time for the interview.

Selection of focus group discussants (students) were also conducted by negotiating with the deans and heads of the respective departments. They provided the names of the group representatives of the students learning at each level of each of the departments. While some of the representatives they themselves opted to participate in the group discussion others pointed out and picked whom they thought have better knowledge of the subject under study.

The interviews and the focus group discussions were conducted from the beginning of January to the first week of July, 2014. During each of the interview sessions, each participant was informed that the interview would be carried on voluntary bases and that they have the right to withdraw if they do not want to continue with the interview. They were also asked their permission for recording their voices which most of them accepted, except few. Finally, at the end of interview sessions, each of the participants were requested to sign on the consent form (see Appendix D) prepared by this researcher.

3.3.3.2. Strategies for Data Collection

Three different types of data collecting strategies were used in this study, that is, semi-structured interview, group discussion, and document analysis of various type and nature. These are described below.

3.3.3.2.1. Semi-structured Interview

Qualitative interview is one of the important techniques in qualitative research of all kinds (Myers & Newman, 2007). Interviewing, as one of the qualitative research technique, involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation (Boyce & Neale, 2006: 3). Moreover, the "qualitative research interview probes human existence in detail. It gives access to subjective experiences and allows researchers to describe intimate aspects of people's life worlds" (Brinkmann & Kvale, 2005: 157).

In this research semi-structured interviews, which are sometimes referred to as "focused interviews" (Beverley, 1998), are used as one of the primary data collecting strategy to collect data from purposely selected engineering teachers and key informants from the industry and MoE. Each of the interview sessions took a minimum of 45 minutes to one hour depending on the availability of time for the interviewee and the quantity and the depth of the information provided and the views expressed by the interviewee.

Semi-structured interview as a data collecting device allowed this researcher to collect data from the specific, purposely selected participants and to obtain their perceptions and views (Chism, et al. 2008) on the topic. The semi-structured interview used in this study was not rigidly structured and, therefore permitted the interviewer to encourage the interviewees to talk at length about the topic of interest. It allowed the informants to focus on the questions and to explain the reasons underlying the problem and/or the practice in the target group and ultimately helped the researcher to elicit rich, detailed data that could be used in the analysis (Lofland and Lofland, 1995).

Interviews are regarded as the "most important sources of case study information" (Yin, 2003: 89). Data were also collected using a semi-structured interview from the purposely selected participants of the industry and MoE to capture their perceptions of engineering curriculum development process and its practices, their observations of the performance of engineering graduates, and their views of their own participation in the process and practice of engineering curriculum development process and its practices.

Since the interview questions were prepared in English and directed to teachers and students of higher education, conversation took place in English with many of the participant teachers, except in few cases where Amharic language was used based on the choices of the participants themselves. Questions for the interview were related to the four research questions indicated in Chapter One (See Appendix B). For each of the research questions two to four questions (including the probing questions) were presented to the participants. The responses provided by most of the participants were recorded by tape recorders in some cases and by an electronic voice recorder in others. For those who did not want their voices to be recorded (one teacher in ASTU and two teachers of AAiT), the researcher used field notes for recording their responses.

3.3.3.2.2. Focus Group Discussions

In focus group discussion, participants were requested to present their own views and experience, but also hear from other people (Ritchie & Lewis, 2003: 171). Participation in the discussion was on voluntary bases. The researcher informed the participants (before and during the discussion) what the aim of the research is and that there is nothing to fear to talk whatever they want to talk as long as it is related to the discussion points posed by the researcher. They were also informed that their names will not be disclosed and anonymity or pseudonyms may be used in reporting the research results. It is believed that a focus group "presents a more natural environment than that of the individual interview because participants are influencing and influenced by others – just as they are in real life" (Kreuger and Casey, 2000: cited in Ritchie & Lewis, 2003: 171). Focus Group, in general, involves six to eight people who meet once for a period of around an hour and a half or two hours.

The Focus group strategy employed in this study involved purposely selected 3rd, 4th, and 5th year students of Mechanical, Civil, and Electrical engineering within each of the selected institutions. The number of participants involved in the focus group discussions within each of the institutions was at most six students. The time taken for each of the discussion sessions ranged from 1 hour and 45 minutes to 2 hours and ten minutes. The language of communication in the focus group discussions held in each of the sites was Amharic because of the participants' decision that Amaharic language would enable them to express their ideas and views better than the English language within the group. This strategy (that is, the focus group discussion) was so important in capturing data pertaining to the views of the students with regard to their understanding of the engineering curriculum and what was actually happening in the process of teaching/learning including the process of assessment and the problems associated with it, within their respective campus classrooms and/or workshops, and with regard to their relations with their teachers and their practice of internship within industries.

3.3.3.2.3. Document Analysis

Additional data necessary for the study was also collected from print and other recoded documentary sources which included curricular documents, books, agendas, and minutes of meetings, course catalogues, framework directives, yearbooks, and other pertinent materials. Such documents were of great value to the researcher in examining the perspectives, contexts, directions, and purposes of education and curriculum development in general and of engineering education and curriculum development process and its practices in particular. Context specific materials such as the Ethiopian Education and Training Policy (ETP), the Growth and Transformation Plan (GTP), Education Sector Development Plans (ESDP), proclamations, and many other documents of such type have provided the general and particular contextual information for this study. Engineering curricula frameworks, curriculum guides and other related documents have also provided information about the intentions, mission, aspirations and contents of the engineering education practice. It is asserted that "For case studies, the most important use of documents is to corroborate and augment evidence from other sources" (Yin, 2003:87).

3.3.3.2.4. Pilot Testing

It is pointed out that a pilot study in qualitative research is necessary in order to determine whether there are flaws, limitations, or if there are weaknesses within the interview design, and if it is necessary to make the necessary revisions prior to the implementation of the study (Kvale, 2007, In: Turner, 2010). Robert Yin also asserts that a "pilot case study will help" to "refine …data collection plans with respect to both the content of the data and the procedures to be followed" (Yin, 2003: 79). In another words, a pilot study, in general, is believed to have the “potential benefits in putting a toe or two in the research waters before diving in” (Sampson, 2004: 399).

Hence, a pilot case study was conducted in one of the similar engineering education sites with teacher and student participants who have similar interests as the participants for the main study. The pilot study involved conducting interviews with selected teachers and a focus group discussion set by this researcher. The main criteria in selecting the site for the pilot case study and the participants from within the site were convenience, access, and geographic proximity. Conducting the pilot study has helped the present researcher in checking the relevance and capability of the interview questions to generate answers for the main research questions, in achieving the objectives of the study and in gaining the techniques of interviewing and conducting focus group discussion that were intended to be employed in the main research process.

Equipped with this experience and the data collected from the pilot study the researcher was able to have some modifications on the interview questions, which he found not clear or cumbersome to understand for the interviewees. Based on this feedback from the pilot study, the necessary corrections and adjustments were made for the subsequent conduct of the interviews and focus group discussions that were employed in the main research process.

3.4. Data Analysis Procedure

Since analysis of data in qualitative research requires an iterative approach and interim analysis (Creswell, 1998; Plays, 1997; Silverman, 2000), data analysis, in this study began at “the start of the research study” (Ritchie & Lewis, 2003: 199) and it continued as inherent and ongoing part of the research throughout the process of data analysis. It was performed all the way through; beginning to end, by organizing the field notes, transcribing the tape/electronic recorded interview responses and the focus group discussion results and writing up the results. However, to analyze the data obtained from the interviews and from focus group discussants, the researcher had been influenced by the approaches of both (Ritchie & Lewis, 2003) and (Yin, 2003) and had made use of both approaches in the data analysis. In the sense of Ritchie and Lewis (2003), analysis is targeted towards answering questions about "the contexts for social policies and their programs and the effectiveness of their delivery and impact". According to Yin (2003), there are three general analytic strategies, i.e., "relying on the theoretical propositions", "rival explanations", and "case descriptions" (Yin, 2003: 209). This researcher used the theoretical propositions especially when doing the cross-case analysis.

3.4.1. Transcription

Primary data were originally collected using audio tape recorders and in some cases using electronic voice recorder. Where this was not possible, the researcher handled the responses of the interviewee, primarily in the form of hand written field notes which were later organized in appropriate format. All data recorded on either the audio tape recorder or on the electronic recorder, together with the data collected using field notes were transcribed, typed on a word processor, and are made available in print format with a wider margin in the right-hand side. Since some of the interview responses were in Amharic, they were also translated into English and are made part of the data. Translation was made primarily by the researcher, but for checking its reliability and plausibility of the language usage, part of it was forwarded to an English language expert and checked.

The process of transcribing the data was one of the significant parts of the analysis since it gave to the researcher the opportunity to be familiar with the data and to make some significant notes. Finally, transcripts were checked for errors by listening back to the audio-recordings and reading the transcripts simultaneously. The researcher read and re-read each transcript, and listened back to the audio recorded interviews to become more familiar with the whole data set.

The familiarization process was essential, especially for recording initial impressions in the margins of transcripts, for example where participants expressed exceptionally strong or contrasting views. Interesting or important segments of the text are underlined and the right hand margin was used to describe the content of each paragraph with a label. The same margin was used to describe more detailed notes and ideas, for example questions to bear in mind as the analysis proceeded, and ideas for explanations or patterns in the data. For conducting the analysis of the data in this research, the background information, the four research questions which are indicated in Chapter One of this dissertation together with the perspectives related to education, curriculum and curriculum development process and practice in general, and engineering education, curriculum development process and practice in particular (Chapter Two) provided the theoretical propositions/themes.

3.4.2. Credibility and Trustworthiness

In the conventional positivist approach, terms such as validity, reliability, and objectivity are criteria used to evaluate the quality of research (Payton, 1979). Since the interpretive method differs from the positivist tradition in its fundamental assumptions, research purposes, and inference processes, using the same criteria for judging qualitative research results is unsuitable (Bradley, 1993). Recognizing this gap Lincoln and Guba (1985) posit that credibility, dependability, conformability, and transferability, as the main criteria for evaluating interpretive research work.

For ensuring the credibility of the research, the researcher devoted ample time within the work vicinity, that is, within the institutions in which the research participants were working. This provided the researcher a chance to obtain more clarification and to understand their views and responses in depth. In most cases, a qualitative researcher is regarded as part of the research (Aamodt, 1982) and not separate from it and such an engagement allows him/her to check the perspectives of the informants which, at the same time, helps the participants to become accustomed to the researcher (Kielhofner, 1982). Moreover, the researcher tried to understand the data clearly through repeated reading and finally reduced it to simplify its complexity by extracting recurring themes.

In some instances, the transcribed interview texts were given to the interviewees for member checking to see if the data make sense. This is believed to decrease the chances of misrepresentation (Lincoln & Guba, 1985). In one of the research sites two draft copies of the report regarding the particular site were also given to two participants to see and comment on the actual report. The feedback from them was also incorporated where necessary.

To further enhance the credibility of the research, evidences from interviews, and focus group discussion including the information secured from document analysis are triangulated and checked against each other to minimize distortion that might arise from using a single data source. Triangulating data from the different sources enabled the researcher to see the consistency of responses and the converging or diverging nature of the ideas or responses. Triangulation is believed to be a powerful strategy for enhancing the quality of a research, particularly its credibility (Krefting, 1991) and it is based on the idea of convergence of multiple perspectives for mutual confirmation of data to ensure that all aspects of phenomenon have been investigated (Knafl & Breitmaye, 1989, In: Krifting, 1991). In addition to this, with the intention of receiving feedback that would help to improve the inquiry findings, the research as a whole and the findings were presented to the curriculum and instruction teaching staff of ASTU into which the researcher is a member. Finally, the draft copies of the research were given to two readers for their feedbacks and suggestions with regard to the whole nature of the study and the methodology used. All of these were further incorporated as supportive feedback to correct some of the errors and pitfalls of the study. As mentioned earlier in this chapter, data for the study were collected using different strategies, that is, semi-structured interviews and focus group discussion mainly. These were made available in print and electronic forms for anyone who would like to corroborate the data.

3.4.3. Issues of Responsibility and Ethics with Regard to the Participants of the Study

Realizing that interviews including focus group discussions have an ethical dimension and that it is concerned with interpersonal interaction and produce information about the human condition, this researcher has established a consent form (Appendix A and Appendix G) which the participants of the interview and the researcher had to sign on, after reading it thoroughly and reaching agreement. The form included the purpose of the research, the problem that was addressed, the methods used to gather the data, and the groups who would be involved in the study.

Participants, particularly those involved in the interviews, were also briefed what was expected of them and that it was only when they agree that they would give their consent, that they have the right to refuse to participate and that they could withdraw without penalty even after the beginning of the research. It was also made clear that anonymity of persons and/or confidentiality of their data is protected if appropriate.

Similarly, participant students were communicated orally about the ideas of the research and its aims and their participation in the group discussion is on volunteer bases. They were also informed that they can withdraw at any time if they don’t want to participate. Communication of this matter took place not only once in groups but also individually during their invitation to the focus group discussion.

CHAPTER FOUR

PRESENTATION OF EMPIRICAL RESULTS

4.1. Introduction

The empirical results for the case study of the "new engineering curriculum development process and its practices in Ethiopia" are organized and presented in chapters 5, 6, and 7 separately; representing each of the three sites within which the study is performed and within which the new engineering curriculum is implemented. The cross-site results are presented under Chapter 8. Since the same semi-structured interview questions, focus group discussion questions, and related document analysis of each of the sites, were used as tools for data collection from each of the three sites, the same thematic topics and sub-topics are identified and used to present the empirical data for each of the three sites under each of the chapters.

The empirical results presented in each of the chapters are obtained from the analysis of the data pertaining to the interviews of the engineering teachers, deans, department heads, and from selected industry personnel including the focus group discussion of engineering students in each of the three sites. The data were analyzed following the procedure discussed in chapter three and were sorted and grouped into various categories and themes. At the end of the categorization process, twenty major categories were identified each with its own sub categories except the first one indicated on the following list of themes. Furthermore, these categories were collated under seven thematic areas for presenting the results in a coherent and systematic way under each of the chapters. The main thematic areas are:

- Initiation for Change of Engineering Education and Curriculum
- The institution as a Context of Engineering Curriculum Implementation
- The Engineering Curriculum Development Process.
- The Content of Engineering Education

- Teachers' and Students' Perceptions of Engineering Curriculum.
- The Interface Between Engineering Curriculum Expectations and Engineering Education Practice (Implementation)
- Challenges of Engineering Curriculum Implementation.

The following Table shows the seven thematic areas and the twenty categories obtained using the Framework analysis procedure. There is not a one-to-one correspondence between the thematic areas and the research questions at this level. Accordingly the empirical results for each of the themes are presented in chapters 4, 5, and 6. The cross site analysis is presented in Chapter 7.

Table 4. Themes of Analysis

Themes	Categories
• Initiation for Change of Engineering Education and Curriculum	
• The Institution as a Context of Engineering Curriculum Implementation	• Geographic location • Experiences prior the engineering curriculum reform • Engineering curriculum reform
• The Engineering Curriculum Development process	• Policy initiatives • Curriculum development within the institution • Teachers' participation in curriculum Development
• The Content of Engineering Curriculum	• Professional and personal attributes • Expectations of curricula • Knowledge and skill base • Content as a means of achieving the country's objectives
• Perceptions of the field of Engineering and Engineering Curriculum.	• A plan for student learning • A Means for fulfilling a country's objectives. • A Means for creating Engineers who are critical Thinkers and who are capable of doing things by themselves
• The interface between curriculum expectations and engineering education practice (Implementation)	• Teaching and Learning • Apprenticeship • Assessment
• Challenges of Engineering Curriculum Implementation	• Curriculum Revision • Teacher Quantity and Quality • Student Population • Budget and Resources

4.2. Initiation for Change of Engineering Education and Curriculum

Though not always, the ideas of recent reform activities, in Ethiopia, in many of the social and economic sectors by and large emanate from the Government's provision of proclamation No. 256/2001 "Proclamation to provide for the Reorganization of the Executive Organs of the Federal Democratic Republic of Ethiopia" (FDRE, 2001).

As far as this research is concerned, a significant component of that proclamation was the provision in the reorganization of a number of different Ministries and commissions, including the Ministry of Education, under the coordinating responsibility of the "Office for the Coordination of Capacity Building" (OCCB) (Proclamation 256/2001, Article 5, sub-article 1). According to this provision, the Ministry of Education was accountable to the Office. The Office, which was sometimes referred to as the Ministry of Capacity Building, was authorized with the powers and duties to: (1) initiate national capacity building policies; (2) ensure that the necessary capacity is created for the national capacity building; 3) supervise and coordinate the executive organs[2] identified (4) support regions in promoting capacity building activities; and (5) perform other activities necessary for the enhancement of capacity building. In other words the reform in higher education also had its roots in the "Sustainable Development and Poverty Reduction Program" of Ethiopia (PASDEP) (MoFED, 2002) which was an extremely wide ranging and ambitious program.

The objective of higher education as indicated in this document is to "Produce medium- and high-level trained manpower resources in sufficient quantity and quality for poverty reduction and sustained growth" (MoFED, 2002: 191). According to the provision of responsibility for implementation programs in this document, policy measures that concern the building of capacity in the private and public sector including the preparation

---

[2] Ministry of Education; Ethiopian Science and Technology Commission; Federal Civil Service Commission; Ethiopian Management Institute; Ethiopian Civil Service College; Justice and Legal System Research Institute were the executive organs that were accountable to the Office for the Coordination of Capacity Building.

of program for the development higher education was the mandate of the Ministry of Capacity Building (MoFED, 2002: 177)

Documents reveal that the launching of the initiative for the reform of engineering education which took place in 2005 was attributed to the leadership of the Ministry of Capacity Building (MoCB) (Waidmaier-Pfister, et.al, 2008) and with the financial and technical cooperation of Germany (Ethio-German, Negotiation, 2005) through the regulation of the Engineering Capacity Building Program (ECBP). The motto carried out by the time of the reform was “Building Ethiopia” signifying the overall reform of higher education and training and capacity building that was aimed at “creating country wide sustainable human resource capacity that is responsive to changing circumstances” (MoE, 2002: 3). Hence the reform in engineering education was more of responding to the need of industry which was fueled by the government’s idea of “accelerating industrial development in Ethiopia” (Knoop, n.d). The main aim was to support the private sectors through supporting the institutions that support them, among which the university program was taken as one pillar (pillar No. iv) within the ECBP. The university reform component of ECBP was then intended to support the transformation of higher education, which in this case means engineering education, to deliver most needed human capital for the labor market. The objectives with regard to this were stated as the following:

- *Development and governance of efficient institutes that work at the intersection between higher education and economy*
- *Implementation of engineering study programs based on international standards;*
- *Integration of technology transfer approach to provide solutions to industry.* (Knoop, n. d.)

In line with these objectives, some engineering Faculties such as that of the Faculty of Technology of the Addis Ababa University and Bahir Dar University, including others were changed into Institutes of Technology (IoT). IoTs, as pointed out by the Engineering Capacity Building Program Component 1: University Reform (2009), are centers for excellence in teaching practice-oriented applied technology education in which its graduates develop the required skills by way of industrial apprenticeship.

Hence, curricula for the various engineering fields of studies were developed and implementation was begun in Academic Year 2006/2007 in some of the IoTs, at least in the pilot form. Program provision also continued in the subsequent years within the rest of the IoTs and engineering faculties.

4.3. ADDIS ABABA INSTITUTE OF TECHNOLOGY (AAiT)

4.3.1. Introduction

This chapter deals with the first case, Addis Ababa Institute of Technology (AAiT) as part of the overall case study of the curriculum development process of engineering education program in Ethiopia. The seven themes and the respective categories indicated here in above are used as the bases for the presentation of the empirical results, in the Chapter.

4.3.2. The Institute as a Context of Curriculum Implementation

The sub-topics presented in this part include location, programs, and student population, experiences of AAiT prior to the engineering curriculum reform, and engineering curriculum reform.

4.3.2.1. Location, Programs and Student Population

The present AAiT campus, until recently, was a part of the long existed and well recognized Faculty of Technology under the jurisdiction of Addis Ababa University. It received its present status of an institute and name change to Addis Ababa Institute of Technology (AAIT) in 2010 (AAU, 2011; Kim, 2013: 115). At present, AAiT is one of the autonomous “teaching institutions” of Addis Ababa University (AAU, 2012: 25) which is “led by a Scientific Director with the rank of University Vice president” (Asres, n.d.). Many people, within the institute itself and outside it, regard that AAiT is one of the leading Institutes of Technology (IoTs). As pointed out by ECBP (2009: 20) an IoT is a part of a university with a special autonomous status. The vision statement of the institute also indicate that the Institute of Technology (IoT) is believed to be a home for technology and engineering that is focused on educating professionals and providing university-level knowledge to serve Ethiopia's needs (ECBP, 2009: 9). One of the IoT's mission statements, among others, is "to serve as a model for other educational institutions within the country and provide them with the necessary technological education and advanced training" (ECBP, 2009: 9). Some of the participant teachers in AAiT are even more confident to tell that AAiT is a leading and a model institute for other universities. The following is just one example of such a belief.

> As *you know we are considered as leading institute for other universities. …so we are the model for other universities, regarding curricula and laboratory set-up. Even our senior and young staffs have been participating to teach engineering students in other universities* (N. 16: p. 301).

As pointed out by the participant in above, it is obvious that most of the higher education institutions established recently and who are running engineering program seek direct or indirect advice (in most cases academic and in some cases administrative) and help of this senior and the most experienced institute. Since many of the senior engineering teachers are found in AAiT it is also true that these staff could help the other institutions in the engineering teaching learning processes.

The present AAiT campus, for many years in the past, as part of the Faculty of Technology, was identified as the Northern Campus. It has been housed in its present location (Amist Killo) and in its present building since the year 1969. At present, AAiT, is structured with four schools of Electrical and Computer Engineering, Mechanical and Industrial Engineering, Chemical and Bio Engineering and Civil and Environmental Engineering. AAiT caters a total student body of 9122 among whom 6916 are undergraduate students, 1322 postgraduate Master's students and 65 PhD students (AAU, 2013: 117) in all engineering programs.

AAiT in its educational provision conducts four undergraduate programs which include Electrical and Computer Engineering, Mechanical and Industrial Engineering, Chemical and Bio Engineering and Civil and Environmental Engineering with ten different areas of specialization. In addition to the undergraduate programs and areas of specialization, the institute in general, provides 33 postgraduate programs with many students enrolled in it. It is also characterized by its three Centers of Excellence related to water, energy and logistics.

4.3.2.2. Experience prior to the Engineering Curriculum Reform: Addis Ababa University Faculty of Technology

The history of engineering education in Ethiopia goes back to 1953. Even though it was began and administered by the Ministry of Education" (Demis, Alem, Daniel, and Edessa, 2006: 9) as the Imperial College of Engineering (RESR, 1973), for a while, a significant bulk of its development and history refers to the Faculty of technology of the Addis Ababa University from which the present AAiT emerged.

The Faculty of Technology used to have two campuses "each with distinct beginning of its own" (Bayou, et al. 2006) until recently. Before it grew to the faculty level, as a college, it offered courses of two-year program of intermediate engineering as a stepping stone for the students to subsequently continue their further study abroad at Bachelor of Science (B.Sc.) level (RESR, 1973; Bayou et.al, 2006). But two years later a four year program was introduced in civil and industrial engineering on top of the two-year pre-engineering education. The first graduation of engineers, in the history of Ethiopia, at degree level took place in July 17, 1958 (MI, 1960). But, later instruction in Industrial Engineering was phased out and the college was expanded to include instructions in Mechanical and Electrical Engineering.

In 1963-64 the curriculum was revisited with the assistance of groups from Israel and changes in some core areas of engineering were made (AAiT, n.d) in such a way that it suits the demands of some of the then growing industries of the Ethiopian Electric Power and Light Authority (EELPA) and the Ethiopian Telecommunications Authority (ETA), respectively (AAiT, n.d). The curriculum was reviewed again in the 1968-1969 academic year, when the University undertook a complete overhauling of programs of studies in all of its colleges and faculties to consolidate and streamline programs of study. During the 1968-1969 curriculum review separate task forces were set to work on updating and streamlining of the different programs and courses that include social sciences and the natural sciences. The natural science was divided into life science and physical science courses. Courses in the physical sciences were again divided into physics, mathematics, geology, and engineering disciplines. At this time of history the undergraduate engineering program and the courses covered within it were made to last in five years (Demis, et al. 2006). Later, in the 1970^{th} when the University's name was changed from Haile Selassie I University to Addis Ababa University, the programs of the undergraduate engineering education were cut down to four years (Demis, et al. 2006). But, it was restored again to the original five year program after sometimes, that is, after four cycles of graduation.

4.3.2.3. The Engineering Curriculum Reform in AAiT

Though engineering education and engineering curricula, compared to other universities, were not new phenomena for the teaching staff of the Faculty of Technology at Addis Ababa University, the idea of the recent reform of engineering education did not emanate from within the institution. It was an idea that was brought by the then Ministry of Capacity Building (MoCB) to Addis Ababa University through ECBP. Though they ended up to be active participants in the reform process, either the institute or the teachers within it were not the initiators of the reform. Upon the quest made to know and to understand the degree of the involvement of the Faculty of Technology at the initial stage of the reform, one participant of this study indicated the following:

> *Actually I don't know any study that the university had made. It (referring to the idea of the reform) all came from the ECBP, and there was a strong position that there was a need for the reform of engineering program. And the universities were required to make the reform. In fact, as I learned from the Ministry, the Addis Ababa University was asked to take the lead in the reform and to do it by itself at the institution level. But the university at that time did not opt for doing it on its own* (N. 20: p.370).

What can be seen here is that the idea of reforming engineering education was not from within the educational institute; neither by teachers nor by the leaders of the institute. As pointed out by the participant of the study, the idea of the reform came directly from the ECBP and the university allowed the Faculty of Technology to be involved in the reform activity with ECBP. Hence, selected teachers and leaders from the Faculty of Technology were the first participants in the initial reform activity; of course in collaboration with the ECBP. AAiT, as a separate institute, as it is now, did not exist by the time the engineering education reform began; it is rather one result of the reform itself.

The Faculty of Technology at Addis Ababa University during that time comprised seven departments of Architecture, Chemical Engineering, Civil Engineering, Electrical and Computer Engineering, Construction Management, Mechanical Engineering, and Urban and Regional Planning. It was selected by the ECBP because of its relative strength compared to other engineering education providing institutions in different fields of engineering studies.

The strength of the faculty at that time was manifested in different aspects. There were 49 PhD, 58 M. Sc. and 42 B.Sc. holders excluding part time staff (Bayou, et.al. 2006: 38). According to an assessment conducted by Cordier in 2007, during the start of the reform, the Faculty of Technology had sufficient and the best staff available in Ethiopia “qualitatively speaking” (Cordier, 2007: 41) who could run bachelor and graduate program. The quality of the Faculty’s staff was not only dominant in the academic field but also in the field of practice (Cordier, 2007).

At the time of the reform within FoT there were five M.Sc. programs, out of which four were provided in the present AAiT campus while one was taught at the former Southern campus which is now called as Ethiopian Institute of Architecture, Building Construction and City Development (EiABC). Provision of PhD programs were also on the way to be launched in some departments like Architecture and Urban Planning. Until that time, graduates willing to achieve their PhD have had to go abroad to do so (Cordier, 2007: 40). Even though these were features regarded as a sign for the relative strength of the faculty of Technology, on the other side, the Faculty’s endeavor of teaching and learning was not free from criticisms. Though there were highly qualified teachers and relatively well organized laboratories and workshops for the teaching learning purpose, many people, including its own staff thought that the teaching learning process was inefficient, For instance, the Faculty Reform Steering Committee (RSE) that comprised 10 members of the Faculty and which was established under the framework of the ECBP in 2007 pointed out that:

> *the education in the FoT was not sufficiently practice oriented, graduates were not problem solvers, its administration and governance system is plagued with undue centralization, insufficiency and lack of transparency. Furthermore, the Faculty's weak link to the industry has led to inability to make curriculum and research relevant to the needs of the country and, therefore, has resulted in its limited contribution to the national economy* (RSC, 2007: 6).

A participant of this study also confirms this by saying:

> *When we look to the curriculum that existed before the reform, I can say that students who graduated through it lacked getting exposure to the industry before they graduate. But that does not mean that they were not capable of handling the duties they are assigned for. Probably they may have needed sometime initially until they get used to it* (N.18. p. 337).

It is likely that the identification of such pitfalls could have served as one of the catalysts for the undertaking and implementation of the reform at the level of ECBP and at the level of the Faculty of Technology. In other words, such pitfalls and the inherent drawbacks were the important aspects that were needed to be addressed and changed within the activities and implementation of the reform. As pointed out by one of the participants of this study, the reform was directed towards improving the teaching learning process, the linkage between university and industry, and the inclusion of more practice in the engineering teaching. This reads as the following:

> *The reform introduced many things in the curriculum which included the improvement of teaching learning process, university industry linkage and the creation of practice oriented engineers who would solve problems associated with many sectors within the country* (N.17: 298).

4.3.3. The Engineering Curriculum Development Process

The major points that are addressed under this theme include: policy initiative, curriculum development within the institution, and teachers' participation in curriculum development.

4.3.3.1. Policy Initiative

As it has been mentioned earlier in this Chapter, the engineering curriculum reform within the present AAiT (formerly known as Faculty of Technology) was stimulated by the ECBP. The ECBP from the outset shared its ideas of engineering reform to Addis Ababa University which was finally delegated to the Faculty of Technology. As an old and experienced institute, the Faculty of Technology was perceived and expressed as follows:

> *The most eminent role presently has the Faculty of Technology (FOT) at Addis Ababa University (AAU), being the oldest and most advanced faculty in the field of technology. Besides, there are 8 faculties of technology and engineering at regional universities throughout the country. The Analysis of the FOT at AAU gives indications for necessary changes in the governance system. Detailed assessment of the regional faculties will have to be included in a later stage.* (Cordier, 2007: 3-4).

The ECBP focused on the Faculty of Technology, more than any other institutions, to start and work on the reform due to a number of reasons as pointed out herein below:

> *The higher education institutions that offer programs in technology, however, have a widely varied level of development. As it is well known, due to its more than half a century of service and development the Addis Ababa University (AAU) possesses relatively more adequate staff and infrastructure. It is also well known that both the public regional and the private universities depend considerably on the graduates of the AAU* (Cordier, 2007: 36).

The response of the Faculty of Technology to the call of the ECBP was positive to the extent of being "under the direct support and guidance of the ECBP" (N. 20: p.372) in carrying out the reform activities. This was further expressed as "it was actually receiving guidelines and the objectives and ideas sent from the Ministry to make the reform. The university was simply collaborating. So everything, all in all, was done under the Ministry of Capacity Building" (N. 20: p. 372). Within such set up a steering committee comprising 10 staff of the faculty had been established to oversee the FoT reform under the University reform component of the ECBP and followed by setting up of different task forces that dealt with curriculum, industry linkage, E-learning and ICT development, and Governance and organization of reform, (RST, 2007: 6) all of which were contributors to the reform in one way or another.

Even though the Faculty of Technology was regarded as the strongest of the then existing engineering education offering institutions, in terms of having diversified engineering departments, well qualified teachers, and relatively well equipped laboratories, as it is indicated herein above, there were admitted discontents with regard to its inefficiency of not producing engineers that were geared to problem solving. What was pointed out in this regard included that the Faculty of Technology lacked demand driven curriculum, practice oriented teaching learning process, it was hence, characterized by an imbalance between theory and practice in its teaching and learning, absence of graduate programs in marketable trades, absence of entrepreneur training and lack of adequate apprenticeship were among the prominent criticisms provide by then. A participant of this study puts it as the following:

> *In the previous versions of the curriculum emphasis was not given to practice and industry oriented approach. It was mainly focused on theoretical aspect of engineering education. So through time, especially during the recent review of curriculum by the ECBP, it was tried to incorporate some practical aspect of engineering so that the students can get acquainted with industry practices* (N. 18: p. 321).

So, the attempt of engineering curriculum reform was to alleviate such problems and to produce engineers who have the knowledge, skill, and attitude that enable them to solve problems.

4.3.3.2. The Curriculum Development Process within AAiT

As it has been indicated all the way through the preceding discussions the staffs in the Faculty of Technology were active participants of the reform activity along with the ECBP, especially at the beginning. Mention has also been made that different task forces were established under the umbrella of ECBP. In each of the seven departments of the Faculty of Technology reform committees were formed who ultimately developed the curricula for each of the fields of studies in the respective departments (Bayou, et al, 2006: 7). For instance, members of the task force in the department of mechanical engineering comprised four Ethiopian staffs, including the department head, and one professor advisor from Germany. Likewise, the task force in the Construction Technology and Management comprised five Ethiopian staffs and a professor advisor from Germany. In a similar way, the task forces in the rest of the departments developed the curriculum in collaboration with one advisor assigned to each of them.

The steps involved in the curriculum reform or in the curriculum development, as pointed out by one of the participants of this study, were totally different from what was previously known and practiced curriculum development or revision experiences in the context of Ethiopia (N. 20: p. 373). According to this participant, the first step in the curriculum development process was identifying and developing "the professional profile of the undergraduate program" (N. 20: p.374). For this purpose individuals from industries were contacted in many different forums, interviews, and assessments were carried out to find out or identify the kind of engineers needed to produce and to establish the professional profiles.

Moreover, the then existing curriculum was checked for what it had and for what it was missing. It was revised "in and out" with the collaboration of the experienced German professors. Nevertheless, according to this respondent, the curriculum was basically developed by the faculty staff (N. 20: p.375) in a long process as described by his own words in the following:

> *…this took a long process actually, because you know, after each stage of development the industry was contacted for inputs and critics, and of course through the use of different workshops now and then for consultations under ECBP. So, the process went through the ECBP all the way through* (N. 20: 375).

It is believed by the participants of this study that the curriculum developed in that process included the practical aspect of the engineering education such as that of the internship program, the kind of project work to be dealt with, the time allocation, and the balancing of all these so that the graduates would have the confidence in solving problems in the end,

But this was not done without any challenge and debate, as pointed out by the participants of this study. One of the points raised as an issue was the balance between theory and practice. There was an idea that suggested the eradication of more of the sciences and the theoretical parts of engineering education and focused more on the inclusion of practical aspects. On the other side, teachers of the faculty, although they accepted the inclusion of more practical experiences and students' industry exposure, in the teaching learning practice of engineering education, than it used to be in the past, they did not readily accept the idea of the total erosion of the theoretical aspects. They argued that engineering education, in the real sense of the concept, should not be brought down to the level of more of "technical kind" without enough theory that would develop the students' ability of analyzing problems sufficiently. This was expressed by a participant in this study as follows:

> *Since we were many times blamed as theoreticians, which in my view was a bit exaggerated, even industries, when we ask them, told us that our education is focused more on theory and less on practice. But we argued that is how it should be because this is a degree program and it is a university level education not a technical education. We also said that the missing practical gap must be dealt with another level of education like technical education, but the engineers must have an acceptable level of theoretical base so that they would be capable of analyzing critical problems important for their field* (N. 20: p. 377).

As pointed out by the same participant the arguments between the idea of including more practice in the engineering education and the idea of maintaining a fundamental theoretical base in the sciences, mathematics and engineering sciences on the other side, were the two competing arguments that were mainly treated during the time of the curriculum development process. Through such arguments and challenges, according to the participants, served in creating a "balance" between the two competing ideas and resulted in the reformed curriculum, practicing the curriculum in the real situation is still a challenge that needs more attention.

The other face of the resistance from the side of the teachers seemed to be related to maintaining of the already existed engineering education, probably with some minor changes in the form of plus or minus, and provide that to less number of students. This was expressed by one of the participants as follows: "The previous curriculum was said to be weak by the people from above and the idea of changing the curriculum came from them (N. 19: p.360)". Such statement obviously tends to show that there was an implicit resentment or dissatisfaction with what was done in the reform process. As expressed further by the participant herein below, it shows the need for more theoretical aspects in engineering education and the practical gap needs to be addressed in other levels than in engineering education:

> *At that time we proposed an alternative of increasing the number of technician training schemes rather than the massification of engineers. Our idea was to increase the middle level technicians/technologists who are more practice oriented at degree level. Industry needs more of the middle level oriented technologists, may be trained for three years; not many engineers; compared to the middle level engineers. …our suggestion was to train somewhat like what the Germans call Fachschule* (N. 19: p. 367).

As this researcher learned later, “Fachschule”, in the German sense, refers to the “technical” or “special-training school” which is provided after the end of secondary level education; probably, somewhat similar to what is provided in the technical and vocational schools of Ethiopia.

4.3.3.3. A Second Attempt of Curriculum Revision—Harmonization

Though the implementation of the reformed curriculum was not as it was intended to be and entangled with different problems such as that of large number of students in a class or laboratory and the problem of implementing continuous assessment, more recently, as part of the overall need for harmonizing engineering curriculum from the side of the MoE, teachers at AAiT currently have involved in reviewing their curricula. This time, their involvement in revising the curricula seemed to be as a participant in groups of other teachers drawn from different similar engineering education institutions rather that playing a leadership role as it was in the beginning of the initial reform. The idea of harmonization, as it has been understood by the participant teachers, is the “the MoE’s plan for standardization” (N. 17: p. 302). It aims in providing similar inputs to similar courses within different engineering education institutions. The first step in this process was to group the higher education institutions in clusters and allow them to reorganize the curriculum for each of the fields of studies in modularized and harmonized fashion. According to some participant of the participants of this study the idea of modularization is not a new one and nothing is new is introduced in that except trying to improve it. This was expressed by one the participants as follows:

> *Initially, when the curriculum was initiated by ECBP the curriculum was designed in a semi-modularized way. In that curriculum we had modules, but the modules were not grouped in a*

definite way. They were scattered all over and this was problematic in the actual teaching learning process (N. 17 p. 303).

Hence, the process of modularization and harmonization, according to some of the participant, does seem to be changing the curriculum. Rather, it is seen as a way of refining the previous curriculum. This is expressed as the following:

> *Modularization and harmonization is not changing the curriculum. It is a way of harmonizing the curriculum of similar specializations. It is not different from the old curriculum. It is an additional work of refining* (N. 17: p. 306).

However, the idea of modularization and harmonization is not as simple as that. It has additional requirements such as employing continuous assessment that includes more or less the same number of tests or quizzes or assignments (up to six in number) for each course of each semester, conducting classes in similar manner and ways, providing similar content of courses for students at each level and semester, were some, among many others. By the time this research was conducted the harmonized and modularized curriculum was applied only to first year students in AAiT. Students above first year followed the previous curriculum which actually does not require the employment of continuous assessment in the sense of the modularized and harmonized curriculum. Since the modularization and harmonization process is not a finished task its application for the second year students and above is expected to continue progressively in the years to come.

Nevertheless, as there are few supports of the idea of modularization and harmonization there are also others who see the idea as problematic and difficult to implement. This was expressed by one participant as follows:

> *Modularization cannot work for engineering. If we had been asked for advice earlier we would have advised them to drop this idea. But we have not been consulted earlier, but we have been told to do it. I think one who suggests modularization for engineering education must be a person who doesn't have any idea about engineering and engineering education; I would say* (N. 18: 330).

On the other side, the concept of harmonization of the curriculum is seen as a threat for competitiveness. For those who have this view the harmonized curriculum will limit the institutions' competing nature and it would force them just to maintain the minimum standards set in the curriculum. The possibility of going beyond that and to think creatively towards new innovation will be jeopardized. Such an idea which is uttered by one of the participants reads as follows:

> *Harmonization is another problem. I don't know why it is like that. I know that the idea of decentralization is being promoted in this country. But I wonder why it is not working in education. I think every institution has to work independently and maintain its relative competitiveness rather than trying to adjust to a pre-specified ways of doing. Why not every institute try its own way to graduate the kind of engineers who full-fill the professional profile identified and stated in the curriculum. I think the only thing that has to be common for every institution is the graduate profile. The details with regard to how to produce has to be left to the individual institute. I believe harmonization threatens competitiveness. Institutions have to be users of their competitive advantages. Otherwise teaching will remain to be a matter of full-filling minimum standards* (N. 21: 406).

4.3.3.4. Teachers' Participation in Curriculum Development Process

As it has been pointed out earlier, the staff in AAiT, at least those who were involved in the task forces, even though they were not the initiators of the reform, they were active participants in the engineering curriculum reform activities more than any other staffs who were involved in providing similar education in other engineering education institutions at that time. This can be attributed to a number of reasons. First, the option taken by the reform initiators in putting the Faculty of Technology as the first institution that involved in the first practices of the reform. Secondly, the fact that the large numbers of staffs, teaching in the faculty, were more experienced and more qualified in the fields of engineering they were teaching than teachers in other similar institutions. Thirdly, the geographic proximity of the Faculty of Technology with the center of reform initiators gave more chance for teachers to have close communication with the reform initiators than teachers which, at that time were in a similar situation of teaching engineering students in other higher education institutions. Fourthly, the relatively more diverse nature of the programs available in the Faculty of Technology coupled together gave more chance to teachers in the Faculty of Technology to participate in the reform process and to develop the curricula that served as a spring board for other similar institutions.

4.3.4. Perceptions of the Field of Engineering Education and Curriculum

Perceptions of engineering education and curriculum among AAiT teachers is more or less similar to each other and associated engineering education and curriculum with the mechanism of enabling students to solve problems that are prevailing in a society. As a number of participants indicated, engineering education refers to the study of a combination of engineering sciences, related mathematics and the skills associated with it. Engineering curriculum, on the other hand is expressed as a means by which such education is addressed to the students. For instance, one of the participants of this study indicates:

> *Historically engineering was started to solve problems related to security. It is a wide area. Now it is provided to young people in order to make them able to solve the problem that is prevailing within the society. So engineering curriculum is a means for providing this education and equipping students with the knowledge, abilities and skills that would help them to solve engineering problems* (N. 16: 288).

Beyond informing the historical background of the development of engineering, this participant indicates that engineering education is provided to young people to enable them to solve problems. The main tenet, which is repeatedly mentioned by the participant teachers, is that engineering education is associated with solving problems of society and the curriculum is the plan that contained the concepts and principles to be taught to students. Another exemplar expression of this perception by one of the participants reads as follows:

> *Engineering in general is a profession that uses the application of various kinds of knowledge and skill to solve problems of individuals or society and engineering education is education that provides students the knowledge, skills and the techniques of problem solving. So the curriculum is a detailed plan for providing engineering education* (N. 17: 297).

Such perception of engineering education and engineering curriculum tends to imply that engineering education is directly connected to that type of education which has to do with solving of problems, and the curriculum in this sense, has to be capable of equipping the students with the required knowledge, skill and attitude necessary to solve problems. Ideally, this, with no doubt, is inherent in the engineering profession as many would agree. And this idea is what this researcher managed to trace in the curriculum documents of AAiT all the way through. But the question is has engineering education have really produced engineers who are real problem solvers so far? Does the way it is practiced currently assure the production of such problem solvers?

4.3.5. The Content of Engineering Curriculum

As pointed out herein above in AAiT's case there is no varying perspective (as far as the participants involved are concerned) to what is meant by engineering education and engineering curriculum. The content of curriculum in this study refers to the different parts that signify the structure and the arrangement of the different academic and skill components within the curriculum. More specifically it refers to the major elements that are suggested as a means for the education and training of engineers in various specialties such as that of mechanical engineers, civil engineers and others. The aim in this part, however, is not to give a deep analysis of all the elements available in the curricula documents, rather it is to draw the highlights of the important aspects of the provisions and the expectations attached to it and how these are practiced within the institutions.

Until the call from MoE was suggested to harmonize and modularize all higher education curricula including engineering curricula 2012, there has not been any significant change of engineering curriculum in AAiT. The curricula which were developed under the ECBP and which were started to be implemented in the year 2006/07 remained to be the main guiding documents. The curricula, like any curriculum documents in any educational setting, indicate the content that would help to instill the knowledge, skills, and attitudes in students. Hence, in this part we deal with the highlights of the matters related to the expectations of the curricula and its subsequent practices within AAIT.

4.3.5.1. Expectations of the Curricula

Curricula documents in AAiT (e.g., Mechanical Engineering (2006)[3]) indicate that contents in engineering education are identified and organized in such a way that it helps students to be engineers that have the ability to apply knowledge of mathematics, science and engineering design to solve problems, to conduct experiments, as well as to analyze and interpret data, ability to function in multidisciplinary teams, ability to identify, formulate, analyze and solve engineering problems, ability to communicate effectively, and understanding of professional and ethical responsibility in the students.

Content for the development and attainment of such expectations are arranged and categorized in modular structure such as those of General Engineering Skill Module, Basic Science Modules, Applied Mathematics Module, Advanced Mathematics Modules, Humanities and Social Science Modules, Communication and entrepreneur Module, Core Engineering Modules, Workshop Technology, Computer Aided Drafting and Machine Drawing, Engineering Mechanics, Mechanics of Materials, Advanced Mechanics, Material Science and Machine Elements and Supportive Modules.

Nevertheless, curriculum is implemented by teachers and only by teachers. Though not expressed explicitly by their responses in this study, different teachers in AAiT can have slightly different views of engineering and engineering curriculum. For example, for someone who may view engineering curriculum as a "plan for students' in-depth learning of the field of engineering", the purpose of content is likely to be to enable students to acquire deep knowledge and analytic skill with reference to the particular field of engineering study, which may be Mechanical, Civil, or others. The major focus for the teacher who holds such a view is on creating students who are highly knowledgeable and skill-full in the art of analyzing engineering and other related sciences including mathematics without giving enough consideration how these could be applicable in the practical setting. Even though such provision of academic knowledge and skill could be indispensible in almost all professional activities, the aim in providing an in-depth acquisition of analytic skills of the particular field of study obviously does not imply that

[3] AAU Curriculum Reform, Book VIII, Department of Mechanical Engineering (2006), printed at CCC, Münster, Germany.

the students would be enabled in their skill of applying the knowledge they have learned into a novel and practical situation. Nevertheless, the explicit responses of the teachers in AAiT, with regard to what is meant by engineering education and engineering curriculum, as indicated in the above section of this study, refers to enabling students to solve society's problem.

4.3.6. Teaching and Learning: The Interface between Engineering Education Curriculum and Engineering Education Practice in AAiT

Curriculum development or curriculum planning is one thing and curriculum implementation is another thing. Curriculum implementation as an extension of curriculum development requires inputs of its own to result in the desired output in terms of what students know and what they can do at the end of their specific learning. Curriculum implementation in engineering education cannot be a matter of only using pieces of chalks and other writing and reading materials within a classroom situation.

The requirements for teaching engineering education, compared to the requirements of teaching many courses in the social sciences or humanities or other courses, are numerous and varied. Workshops and laboratories with a special arrangement for each of the fields of studies, special machines and equipments for each of the fields of studies, highly trained and experienced teachers and many other resources are among the primary requirements. The ultimate success in obtaining the desired outcomes depends by and large on how these requirements are fulfilled and on how effectively they are used.

In other words, there is no guarantee that institutional settings of the same level and the same status would implement the curriculum alike. Implementation of the same curriculum at different settings could yield different results in terms of, if not quantity, the quality anticipated and sought in the curriculum document. The reasons for their difference may come from different sources such as the conditions related to the physical setting of the institution in which the curriculum is executed, the capacity, motivation, and qualification of teachers involved in executing the curriculum, and the availability and sufficiency of physical and material resources necessary for executing the curriculum.

4.3.6.1. Engineering Teaching in AAiT

As pointed out in the preceding parts of this study, AAiT has a long experience in teaching engineering education and relatively well qualified teachers. But the implementation of the reformed curriculum was not so easy to undertake even at the start. It was knotted with multifarious problems. As pointed out by the participants of this study, it appears that fulfilling the requirements of curriculum implementation, by then, was given little attention. Hence, it was begun without enough preparation in terms of facilities, equipments and other teaching learning materials. In fact, as it has been mentioned herein above developing the curriculum was one thing and its implementation was another though the two are, in a sense, inseparable.

Even though the curriculum developers, most of whom were teachers of the Faculty, and who worked in collaboration with the advisors from Germany, had made estimation of the cost required for upgrading of facilities such as workshops and laboratories, and equipments, required for the proper implementation of the new curriculum, implementation was began prior putting them in place and started in uncomfortable situation as it is described by one of the participants of this study here in below:

> *The first thing we faced was lack of workshops to practice the "Orientation" course for the first year first semester students. There was no workshop in the faculty to accommodate that huge number of students (which was 2800 students of one intake). So it was not possible to handle. The existing workshops were occupied by students of other level. We finally rented a training workshop somewhere around Lideta which was dedicated for training of industry personnel and shuttled our students for practice in that workshop every day until the end of that course.* (N. 20: p. 386).

The problem with the large size of students was not the only a problem constrained the provision of engineering education at the start. Shortage of classrooms and teachers was also the other side of the problem. The classrooms which were accommodating 40 to 50 students previously were later filled with 90 to 100 students. As a result, teaching-leaning in a classroom situation was limited mainly to the lecture method rather than employing other methods of teaching and learning which are believed to be better than the lecture method.

Although the usefulness of other teaching strategies is being widely examined today, the lecture method still remains to be a dominant way of delivering courses to the large number of students (ranging from 90 to 100 students in a class) at AAiT (N. 16: p. 291). Of course, the traditional lecture method, if used in conjunction with active teaching strategies can be an effective way of teaching and to achieve instructional goals. However, engineering teachers at AAiT as well as students do not seem comfortable with the present arrangement of the class size even for the lecture method as pointed out by one the participants:

> *The problem in these days is the large number of student population. The number of students in a class ranges from 80 to 100. Moreover, what is required these days is to employ continuous assessment and to use the result for improving the teaching and students' learning. But the large number of students per class and dealing with more of such classes makes it difficult to practice what is required* (N. 16. p. 291).

Even though the situation in AAiT is relatively better than the other institutions in terms long experiences in teaching engineering and in terms of having better qualified teachers, participants in this study feel that quality in engineering education is not improving as per the requirements specified in the curriculum due to the increase in the number of students and the incompatibility and insufficiency of the necessary teaching learning materials and equipments required. Almost all participants share the idea that the question of improving the quality of engineering education is not well addressed yet and it is still problematic. One of the participants describes the situation as follows:

> *Even if we try to employ practical exposure of students, such as internship and other work of practical nature, there is still problem of quality. Obviously, quality goes down with the increase in the number of students. For instance, in my time of undergraduate study, one batch was only 80 students. Last year there were 100 graduates and this year it is roughly 800 students. Next year it will be about 400 and in the year after it will be 1200. So you can imagine how drastic the change is* (N.18: p. 339).

The other problem that threatens quality of engineering education is shortage of well qualified teachers within the institute. According to some of the participants, sometime in the past, many of the teachers in engineering education were PhD holders. But these days, there are cases where graduate assistants teach "full courses" to students.

Students who were participants of the Focus Group discussion set by this researcher also confirm to this reality. They indicate that some of the teachers who used to be students like themselves a year before, begin teaching courses soon after they secure their employment as a teacher without any other technical or teaching experience. For instance, one student participant points:

> *Nobody knows how the teachers are selected. In fact they may have the highest grades during their graduation. We see teachers who do not have the ability to teach; even in the subjects they scored the highest grade during their learning. I think the criteria for selecting teachers is high score upon graduation*. (FG. 2: p. 411).

What students indicated here is worthy to consider. They know that scoring high grades is one of the criteria used in employing teachers for higher education. But they do not know what additional criteria are included in the whole process of employment. According to them, relying on high scores for selecting teachers in higher education is sometimes misleading because of the following reasons: (1) high scores in the existing situation of teaching and learning is not reliable due to unavailability of standardized tests and examinations provided; (2) there are a number of possibilities for obtaining high scores other than putting too much effort in the learning, which are simply dependent on the individuals' capability of knowing the tactics of scoring high in each of the courses provided. According to them these include: (a) obtaining past examination and test papers and working on them, (b) knowing the specific characteristics of the teacher who teaches the subject and acting as per those characteristics, (c) using colleague students as a source of getting summarized information and summary of the lessons; and (d) In rare cases, obtaining the exam papers in unknown ways.

According to the participant students, most of the students within the institute, including themselves, use one or more of these tactics to exist as student within the institute. But they do not deny that there are very few individuals who stick to their study properly, digging deep into the subject and having control over the knowledge and skill required. According to the participants of the focus group these students are not many in number compared to the vast majority of students, and sometimes they may not be the ones who score the top scores.

4.3.6.2. Internship as a Method of Teaching

Another significant point which is raised as a problem in the teaching learning process of engineering education in AAiT is the use of internship. A close examination of the curricular documents reveals that internship is a mandatory component of engineering education. In many cases students leave their campuses for one semester long internship training in industries after they completed their six semesters of in-campus study. Internship is believed to be potentially important for engineering students as it gives them the chance to know and understand the realities in work situation. It is also believed that the practice in internship would help students in filling the skill gap which they don't get during their in campus studies. But its application so far is not regarded as satisfactory by teachers, students, and industry personnel who participated in this study. Let us see below how this claim of the reality is revealed by a participant teacher:

> *Students will be exposed to internship for one semester but it is not conducted as we expect it to be. Because many students, from various universities join in the practices of internship and they occupy the spaces available in the surrounding industries. As a result, students will be forced to look for industries outside Addis Ababa; a situation which is not convenient for both students to meet periodically* (N.17. p. 307).

Since more of the larger industries, with the capacity of providing the skills needed by students are situated in Addis Ababa, and this is not the case in other areas, it would not be difficult to speculate that more and more students from various universities could come to industries situated in Addis Ababa for their internship. This is said to be one of the 'bottle neck' for students in AAiT to practice internship properly. This is also confirmed by one of the student participants as follows:

> *The practical skills we receive in our workshops are very limited. In addition to that we sometimes go out for industry visits. It is like an entertainment for many of us; we neither write report on it nor we do research in connection with it. The other is internship. It is also problematic. For instance, it is me who found an industry for my internship practice since we were forced to do so. But there was no follow-up from our teachers during our practice there.*

As can be seen here, the concern of the students is lack of follow-up from the side of the teachers. This also seems consistent with what one of the interviewees of this study from industries has indicated.

> *Students come here sometimes by their own and sometimes guided by their teachers without identifying their specific area of practice. Neither the teachers nor the students tell us what they want and where we specifically put them for their internship training. We always face problems in*

this regard. Students have to identify some specific areas before they come for their training (Ind. 4: p.).

It is worthy to note here the message implied by this interviewee. The message is not difficult to understand. It is crystal clear. The practice of internship has to be guided by some kind of well defined principles. It also requires that students have to identify clearly the areas of skill on which they should focus more, rather than coming up with a broad area of a field of study. It also suggests that both teachers and students must be knowledgeable and have a clear idea about the internship training on which the student focuses.

4.3.6.3. Student Assessment and Quality Assurance

In examining the curricular documents at AAiT one can understand that student assessment before the reform was restricted mainly to students' writing of mid semester and final exams. However, some project works and assignments also made part of the final assessment (Imam, et al, 2006: 27). But the reformed curricula, at least in the descriptions provided with regard to assessment, stipulate that assessment needs to be continuous and that a "holistic" examination, which includes the overall students' understanding of the courses they have learned within the three years, be employed at the end of three years of study. However, when one further examines the assessment mechanisms with regard to each of the courses, assessment seems to be limited to 10% assignment, 30% mid exam, and 60% final examination. Student assessment in AAiT has not changed much in the sense of what is suggested in the reformed curriculum. Neither continuous assessment nor the "holistic" examination is addressed properly. The reason for not applying continuous assessment is attributed mainly to the large number of students that every teacher has to handle. According to the participants in this study:

> *When grading students' knowledge/competency the criteria and the activities included are the Mid and Final examinations. Projects (where applicable) and other assignments are usually given in groups. These days it is very difficult to give students individual assignments due to their large number in each group.* (N. 16: p. 296).

From this, one can see that student assessment is more limited to mid and final examination. It is only in some cases that assignments and projects are included as part of the student assessment. This implies what the curricular documents suggest, as a rule of thumb for assessment, is a futile exercise that remains on the document rather than serving as a practical guide and working instrument.

The other important thing that deserves due consideration here is the suggestions provided by the curricular documents with regard to the "holistic" examination. As it has been mentioned in this part of the study earlier, the curricular documents indicate that students will take a holistic examination that includes the content of the courses they have covered until that particular time. But it appears that no one is responsible to apply it so far. Some of the teacher participants in this study do not have even the slightest idea about whether it existed or not and what is happening with it.

> *This idea is raised by many people. But it is not yet implemented. I am not sure whether other universities have applied it. I think this has to be done by the Ministry or by any other government bodies* (N. 17: p. 319).

Even though the curriculum suggests those assessment mechanisms the way it is addressed in the practical situation appears to be very limited and the practice of assessment at AAiT as pointed out by participant students herein below, is not contributing much either to the improvement of the teaching learning process or to students' learning. A statement posed from one of the focus group participants expresses the following:

> *For many of us the concern is to pass the examination. To pass examination and score good mark is not a very difficult task. What is needed is, simply to collect some past examination papers and work on it, attend lectures, and read the areas the teacher tell you either from the handout he/she provided or a chapter or so from a book. There is no need to take too much time and read different books in the libraries. That is how most of us work and pass examination; and that is what teachers put it in our mind. They tell us on what to focus for our examination, to refer to the lectures they provided, and sometimes the handouts they have given us* (FG. 2: 409).

So what we understand from this is that there is no serious involvement or engagement of students in their own learning a situation which may be attributed to the failure or incapability of the assessment mechanism to do so. Though what some people, call "deep learning" of students is a situation favored to be accomplished by students, what students do is more of what is known as "surface learning".

Another important element to be considered is the question of curriculum evaluation. We do not often find the term curriculum evaluation in almost all of the engineering curricular documents examined for this study in the sense we know it in many of the curriculum textbooks and references. Many of the teachers use the term in connection with examinations, and projects that are provided to the students. Of course, these are also called evaluation though not by all, especially in connection with judging the final grades of students. It appears that the term "quality assurance" has replaced 'curriculum evaluation'. As stipulated in one of the curriculum documents, "the quality of the program offered … is assessed by the performance of graduates and the impact they put on the industrial sector of the company". As far as this researcher is concerned, there is no evidence of such a program assessment so far.

4.3.7. The Challenges of Engineering Curriculum Implementation at AAiT

Challenges of engineering curriculum implementation in AAiT are many. Thus, what is pointed out here is simply a brief description of some of the significant challenges which are related to engineering curriculum implementation within AAiT. Teacher quantity and quality, student population and lack budget and resources are referred to as challenges.

4.3.7.1. Teacher Quantity and Quality

As mention has already been made earlier in this study, AAiT has relatively more qualified teachers than the other similar institutions. It also has a long time experience in providing engineering education. The fact that it is situated at the center of the capital, Addis Ababa also gives it a better opportunity to be linked with many of the country's renowned and big industries since most of these are located in Addis Ababa. Even though all of these features are the true facts of AAiT, the students in the current undergraduate engineering programs do not seem to be the beneficiaries of most of those resources. Participant teachers and students associate this with: (1) the shift to and more involvement of senior teachers in graduate program instead of teaching in the undergraduate program; (2) attrition of better qualified teachers in search of better options in terms of benefits like better salary and study opportunities abroad; (3) the vast number of students in classes, labs, and tutorial sessions, as this limits the possibility of student contact with teacher, laboratory equipments, and workshop machineries, tools and gadgets and (4) the involvement of more and more junior teaching staff in teaching senior level courses. Focus group participant students also recognize that there is a serious problem in the way they are taught and by whom they are taught. For example, one of the focus group discussion participant students puts the problem as follows:

> *For instance, in our department there are three best doctors whom we know. But they are not teaching at undergraduate level. They teach at graduate level. If such teachers would teach the undergraduate level, I believe many students would like engineering as a field of study more than they do now and would perform better. The base for engineering education, as to me, has to be good at undergraduate level. If those senior and experienced teachers teach at undergraduate level, I am sure we would be better engineers than we are now and we will be good problem solvers ultimately* (FG. 2: p.424).

4.3.7.2. Student Population

The lecture class size in the case of AAiT, as pointed out by the participants of this study, is 90 to 100 and in some cases 80 to 100. Likewise, lab and tutorial classes are conducted with a minimum of 40 to 50 students per lab or tutorial sessions. Such problem is expressed by one of the participants of this study as follows:

> *Instructors kept trying to teach as much as their capacity allows. But the large number of students per class hindered the need for addressing the requirement of feedback. In spite of the large number of students and the shortage of resources, I don't see any problem on the structure of the curriculum* (N. 16: p. 294).

Teachers teach two or more of such lecture sessions or lab and tutorial sessions. Sometimes a teacher may teach more than one course for different groups of students arranged in a similar way, and requiring the teacher's preparation for two courses for that large number of students. Moreover, teachers have the responsibility of enabling students to acquire the skills of using laboratory equipments that would help young engineers do their work in the future. The teachers try to discharge such responsibility in a situation where laboratory or workshop facilities are not furnished properly, where students are crowded during each lab, tutorial and workshop sessions and where they cannot follow-up students' activities. Even though one appreciates the opportunity provided for many students to learn engineering, the quality compromise, that follows with it as observed by the participant of this study, is not a problem of the individuals who are currently involved in it, but a problem to the nation as a whole which has consequences in the development of industries and other sectors which demand the use of engineers.

4.3.7.3. Shortage of Resources for Teaching and Learning

The effectiveness of implementing curricula by large depends on the existence material and human resources which may be expressed in terms of well equipped classrooms, laboratories, workshops and the availability of sufficient number and well trained teachers. Without availing such resources as per the standards, it is unlikely that learning will take place properly and the desired results would be obtained. Even though AAiT has a long experience of teaching engineering and the facilities are better than any other institutions involved in teaching engineering, as pointed out by teacher participants as well as students, it cannot be said that all the facilities are in place and materials are plenty. For instance, one of the participants in this study portrays it as follows: *Drawing instruments, the lab equipments, and the books and everything have become under high constraint* (N. 20: p. 397). This, according to this participant, is associated with the large number of students coming to the institution without having enough preparation in terms of availing the necessary facilities and materials required for the teaching learning process by the institution.

Shortages in the facilities and materials can have a negative and irreversible repercussion on the students learning. Once students missed out what they ought to learn as per the set standards and the requirements of the particular course/s, the result at the end will be on the disadvantage of both the students and the society at large. Inefficient engineer will not be confident enough in what he/she does as an engineer. On the other side, the society and industry that are expecting to have and use of the services of engineers will be dissatisfied when they come across such engineers who lack confidence and efficiency in work. The following say of a participant in this study is an indicative of how shortage in the facilities and materials implicate the teaching and learning process. "…then later Massification came and led us to compromise quality. After this occurrence, teaching has become more of theoretical and the idea of project oriented is compromised in many ways" (N. 19: p.366).

CHAPTER FIVE

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY (ASTU)

5.1. Introduction

The analysis in this chapter is based on the following seven themes which are identified and stated on chapter four and the respective categories associated with each of the themes:

- Initiation for Change of Engineering Education and Curriculum
- The institution as a Context of Engineering Curriculum Implementation
- The Engineering Curriculum Development Process.
- The Content of Engineering Education
- Teachers' and Students' Perceptions of Engineering Curriculum.
- The Interface Between Engineering Curriculum Expectations and Engineering Education Practice (Implementation)
- Challenges of Engineering Curriculum Implementation.

5.2. The Institute as the Context of Curriculum Implementation

This part deals with the geographic location, the experiences of the institute prior to the engineering curriculum reform, and the beginning of the engineering curriculum reform within the institution.

5.2.1. Location, Programs and Student Population

The present Adama Science and Technology University (ASTU), is located in Oromia regional state at Adama city, which is found approximately some 90 kilometers away from Addis Ababa in the South-East direction. It is one of the public higher education institutions that was originally established as a Technical and Vocational Teacher Education College in the year 1993 and which is transformed to a university level in the year 2006. By then it was named Adama University (AU) and continued with that name until it finally assumed the present name Adama Science and Technology University (ASTU) in the year 2011.

ASTU, as its name implies, is primarily dedicated to the provision of science and technology education to students who have completed their preparatory education and who come from various regions of the country and who are mandate by the Ministry of Education. By the time the data for this research was collected, ASTU was divided into six schools of: School of Business (SoB), School of Engineering and Information Technologies (SoE), School of Humanities and Natural Sciences (SoHN), School of Pedagogy and Vocational Teacher Education(SoP), School of Agriculture (SoA) and School of Health and Hospital (SoH) (ASTU, 2011: 8). As can be seen here, beyond its primary dedication to science and technology, ASTU as a university, at present, also accommodates a number of other programs including humanities, education and social sciences, and others which are nested within the six academic schools.

ASTU, on top of the academic schools, also hosts institutes such as the Institute of Continuing and Distance Education (ICDE), Further Training Institute (FTI), Adama Institute of Sustainable Energy, Artificial Insemination Institute, and Asella model Agricultural Enterprise (ASTU, 2011: 8).

During the time of collecting the data for this study, that is, in 2013/14 academic year, the statistical data obtained from ASTU's Office of the registrar shows that regular students enrolled in ASTU, were 16,100, among whom 9,449 were engineering and Information Technology students. The School of Engineering (SoE), from where participants of this study were drawn comprises eight departments. At this juncture the researcher would like to make clear that the present ASTU has made a significant change in the whole of its structure that excluded some of the schools mentioned herein above and has also restructured the previous SoE into a number of different schools. Hence, the data, the analysis, and the findings indicated in this study refer to ASTU before its recent change of structure.

As it has been indicated above, the history of ASTU draws back as an institute dedicated to technology education since the year 1993 and this is described separately in the following section for better understanding of the overall context of the present ASTU. Talking about ASTU without mentioning the highlights of the practices, and to some depth, the overall situation of Nazareth College of Technical Teacher Education (NCTTE), would give to ASTU an artificial identity that grew from nowhere. Because, the different technology departments of NCTTE that served as the starting point of the present engineering departments, a number of teachers who taught during NCTTE, the facilities, machineries and tools, etc, that were used during NCTTE, the culture of curriculum development, teaching and assessment that were practiced during NCTTE, at least partially form the present context of ASTU.

5.2.2. Experience Prior to the Engineering Curriculum Reform: NCTTE as a Technical and Vocational Education College

NCTTE which was previously called by the name Nazareth Technical College (NTC) was established as a public college in the Academic year of 1993/94 as a Technical and Vocational Teacher education (NTC Catalogue, 1995). In those early days, it used to have a mission that was stated as "…to advance the quality of human life through strategically selected program of instruction, research and public service emphasizing programs related to technology" (NTC Catalogue, 1995: iv; NTC Legislation, 1992:1). NCTTE as a college dedicated to the training and education of technical and vocational teachers had programs at degree and diploma levels since its beginning in 1993 (NTC Catalogue, 1995). In the evening sessions, technical degree and diploma programs were also provided for those adults who needed to acquire technical knowledge and skills.

The specialized fields of studies provided in those days included Automotive Technology (degree & diploma), Construction Technology (degree & diploma), Drafting Technology (diploma) (but latter it also included the degree program) Electrical/Electronics (degree & diploma), Manufacturing Technology (degree & diploma), and Surveying Technology (diploma) (like the Drafting Technology mentioned above, the degree program was also included latter) (NTC Catalogue, 1995). The regular degree programs in all of the fields of studies were stretched out to four years of duration while the diploma programs lasted two years.

The curriculum which was used for most of the time in the process of educating the technical and vocational teachers (NTC Catalogue, 1995) was a clearly and soundly reasonably organized educational plan that divided the contents of the student's learning in each of the fields of studies into major, supportive, general and professional courses. Major courses referred to the mixture of technological and engineering courses related to each of the respective fields of studies of Automotive Technology, Construction Technology, and the rest of the fields of studies as well.

Technological courses in all of the fields of studies comprised contents which were thought to be useful for the acquisition of knowledge and skills that have to do something with the manipulation of some machines, tools, materials, or artifacts to gain some visible result/s of a process or an activity. On the other side (as an integral part of the major courses), engineering courses dealt with equipping students with the acquisition and understanding of knowledge of the basic mathematics and engineering sciences which were peculiar to each of the specific fields of studies. A teacher who used to teach in those times and who is currently teaching engineering courses confirms this reality as follows:

> *Before the ECBP initiation there was no engineering program at the university. We used to have technology program which was devised to train technical and vocational teachers rather than pure engineering. The courses provided then were more of practical nature compared to the courses in the present engineering program* (N.1: p. 2)[4]

[4] The responses of the interviewees were coded by number and letter. I used the particular paragraph number into which the quotation is found in the primary document. For example (N.1, p 2) refers to the response of Interviewee number 1 and the quotation is located in paragraph number 2 of the transcribed text.

Almost all respondents who used to teach courses of the technical and vocational teacher pointed out that there was no full-fledged engineering program but there were engineering courses within the technical and vocational teacher education program. In spite of lack of evidence for how the first curriculum was developed, curriculum development in the main part of the subsequent years at NCTTE referred to either the development of additional program/s within the broad canvas of the technical and vocational teacher education program or the inclusion of some new courses to the then existed program or the elimination of courses from the program.

Initiating a new program or including a course to the existed program or excluding a course from a program was the responsibility of the departments which represented each of the major fields of studies. Initiatives for starting new program and development or inclusion of new course/s on the existing program or exclusion of course/s from a previously existing program had to start and emanate from within the departments, either initiated by individual teacher/s or by a group of teachers in a given department. So, teachers within the departments, with no direct interference from outside, were fully responsible for the entire curriculum initiation, development, and its implementation. Of course, the process of doing it had to be in line with the institutional regulations and had to pass through the approval procedures within the institution.

When we look at the teaching learning process, teaching major courses, and to lesser extent supportive and general courses, in addition to the usual teaching learning process, required some kind of practices to be performed either in the technical workshops or in laboratories or sometimes in both. The curriculum document (NTC Catalogue, 1995) then stipulated that the proportion of time allotted to theory and practice had to be 40:60, that is, 40 percent of the time had to be devoted on the teaching of theory and the rest 60 percent of the time had to be reserved for the teaching of practical skills within each of the fields of studies. This means that students' learning activities of the major courses took place mostly on the workshop floors or within the laboratories than it would have been within the classrooms. In fact, the teaching learning process of both major and supportive courses by large involved the use of workshops or laboratories and the manipulation of machineries, tools, materials, and other artifacts. So the act of teaching, in such cases, referred to what teachers did in both classrooms and workshops or laboratories in order to put in effect the ultimate goal of student learning. Most of the teachers, including the expatriate teachers from Germany and India, who were in the teaching position by then were supposed to teach both theory and practice and they had the responsibility of conducting both classroom sessions and workshop practices.

Methods of teaching and learning the theoretical parts of the technological courses within the classroom situation, by large, involved lecture method accompanied with some visual displays of overhead projection and to a lesser extent group discussions. Group learning activities were more visible in workshops and laboratories than they were in the learning of the theoretical aspects within the classroom situation. Student learning in workshops or in the laboratories involved dealing with some kind of experiments and observing the results of the experiment in most understandable way or on the manipulation of machines and materials in the process of producing tangible products.

Teachers' preparation for the theoretical part of the teaching and learning process was no more than preparing handouts, and in a lesser extent preparation of transparencies for overhead projection (that was the only advanced teaching aid at that time). However, lecturing remained to be the most dominant teaching and learning method for most part of the teaching of the general and professional courses within the broad program of the technical and vocational teacher education.

The method of assessing students' performance in almost all cases of the theoretical parts, by large, included the use of one mid and one final examination per course per semester. Though this was what was officially recognized, teachers, in addition, were advised not to depend exclusively on those two forms of examination results and had to use other forms of assessment mechanisms such as assignments, some forms of project work, and short tests. This, however, was left to the discretion of the teacher.

Perhaps due the more efforts and time it required, the other means of assessment such as assignments and projects, in many instances, were not favored by many teachers. Most of the teachers preferred to employ mid and final examinations and it remained to be the dominant way of student assessment. Nevertheless, assessing the practical aspect involved more of practical tasks. One of the teachers who used to teach the technical and vocational teacher education courses during those days and who is a participant of this study describes this situation as follows:

> *When we were teaching the 'would be' technical and vocational teachers it used to have more practical work, and assessment seemed to be more of continuous due to the nature of technology education which involved more of practical and lab work and due to the manageable size of the student number. But now partially due to the nature of engineering education itself, and to a large extent, due to the huge size of the student number the focus has shifted towards the provision of more theory than practice* (N. 4: p.67)

Learning courses of practical nature, during those days, required students to perform some activities related to the manipulation of machinery, development and production of practice models, pieces of some useful materials, artifacts, and more in that line, The quality of the product produced by each of the students or in groups or in both groups and individually, measured against a certain kind of criteria set by the teacher, eventually built up to be part of the assessment and that included many similar or different pieces, depending on the nature of the particular course. So, the act of assessment related to the practical performance of students at NCTTE was more of an integral part of the teaching learning process rather than a separate part which was done within a short span of fixed time. The good thing, as pointed out by some of the participants of this study, with that kind of assessment was the promptness of the feedback from the teacher that gave the students chance of correcting the mistakes immediately and improve its quality as per the specified requirement/s.

Teaching and learning in the technological fields of studies, in those days, needed not only the commonly known facilities in any kind of school setting such as classrooms, books, and the like, but also materials completely different from those ones. It needed laboratories, workshops, classrooms, and the relevant equipment and machinery as well as books and other educational materials. Though it was for only 800 students, these were in place and students were able to use them and to practice on the available machines and their accessories sufficiently as required.

All of the workshops by then were moderately equipped with the necessary machines and equipment, accessories, tools and other supporting materials required for the teaching and learning of the skills in each of the fields of studies. In fact, consumable materials of different nature in the different fields of studies were not in abundance, and it remained to be a problem throughout.

Though the workshops and many of the equipment within them are now too old and some of the equipment and machines are also obsolete, according to some of the teachers to whom I spoke and as I observed it in the workshops, many of the old conventional machines, and some of the associated tools, equipments, and accessories are still useable to create and develop the required basic skills that engineering students need.

To conclude this part, let us first summarize the overall picture. NCTTE, as a technical and vocational teacher education college served from 1993 to 2006. The curriculum in the technical and vocational teacher education comprised major, supportive, general and professional courses. The provision of technical courses within NCTTE also included a number of engineering courses some of which are still being taught as part of the engineering program. Teaching and learning at NCTTE included both theoretical and practical tasks. The culture of assessment within NCTTE combined both written exams and continuous assessment that included project work, handling and operation of machines, and manipulation of different materials.

Some of the teachers who used to teach within the program of technical and vocational education are still teaching courses within the reformed engineering education program. This clearly shows the connection between what was then and what is now in terms of curriculum, the culture of teaching and learning including the ways of student assessment. And this is where the present Engineering School of ASTU stands on and aspires to becoming a “first choice in Ethiopia and one of the distinguished Universities dedicated to excellence in applied sciences and technology" (ASTU, 2011: 3; ASTU, 2012: 2).

5.2.3. Engineering Curriculum Reform in ASTU

The provision of engineering courses as an integral part of the technical and vocational teacher education was an experience that existed up to 2007. This means that there was no full-fledged field of study or program designated as engineering education throughout the college's era and at the earlier days of Adama University (AU) (as it was called then). The idea of introducing the engineering program was a phenomenon that took place after the college was transformed to the level of university in the year 2006. Even though the idea of introducing engineering program was creeping in the minds of teachers and institute leaders at that point in time, it was injected by the ECBP through the government's engineering education reform agenda that started in the year 2005.

Teachers who participated in this study witness that the beginning of engineering program reform within ASTU, from the outset, was influenced and shaped by the ideas of the ECBP and not by the institute or by the teachers within it. The following response of an interviewee locates the source from where the idea of a full-fledged engineering was emanated and introduced, and how it was later developed within the institution.

> *We used to have technology courses provided to the "would be" technical and vocational teachers. That was what we had before we started the engineering program. There was no formal engineering program within our institute prior to the ECBP engineering reform initiative. When we began the engineering program we tried to include more mathematics and applied science courses including design courses. It also required more application of design than used to be before. So, most of the laboratories had to be changed to accommodate and serve the engineering program rather than that of the technology program that existed before.* (N.4: p.61).

If we also see the response of another interviewee of this particular study we get, more or less, the same impression that engineering education was introduced not from within the institute but from ECBP.

> *Before the ECBP's initiation, there was no engineering program at the university. We used to have technology program which was devised to train technical and vocational teachers rather than pure engineering program. The courses provided then were more of practical nature compared to the course in the present engineering program* (N.1: p.2).

As pointed out by the participants of this study, the beginning of engineering education at ASTU was totally a government owned and led program on which teachers of ASTU or Adama University (as it was called then) had to agree, adopt, and implement it. Both the institute and the teachers serving in it, played little or no role at the initial stage of the engineering curriculum development other than participating in workshops which were organized by ECBP and adopt the framework produced by it. This was expressed by one of the participants of this study as the follows:

> *While the curriculum change initiation took place at ECBP, I participated partially in workshops, especially at the later stage of the initiation. I don't exactly know the starting point for ECBP's initiation* (N.1: p.3).

5.3. The Engineering Curriculum Development Process

The interview question on engineering curriculum development process was intended to identify the major parties who were involved in the curriculum development process and the influences exerted since the time of the reform. This was in response to the research question no. 1 stated on page 17. The interview responses are grouped into three broad categories: policy initiatives, the institution, and teachers' participation and presented herein below.

5.3.1. Policy Initiative

As has been mentioned earlier in this part of the study the process of curriculum development in ASTU began and influenced by the ideas of the ECBP. Neither the idea of initiating it nor the creation of the framework for developing the curriculum was from within the institution. To begin the endeavor of curriculum development, some selected teachers were invited to the workshops that were organized and conducted by the ECBP at its head office in Addis Ababa. While some of the teachers participated from the beginning, others participated on some of the workshop occasions. Even though some of them participated on those workshops from the beginning and some at the later stages or in between, many of them did not know exactly how it first began and where the starting point was. Even some of those who thought they knew it, did not have deep understanding. See for example the following statement which was provided by one of the participants in this study:

> *I participated, for a while, when ECBP first initiated the engineering curriculum, especially at the later stages. It was ECBP together with the leading universities such as Addis Ababa University, Baher Dar University, Jima University and Arba Minch University that made the first assessment and came up with the idea of improving the engineering curriculum* (N.3: p.37).

The statement is clear if not true in what it says. However, in reality, there is no evidence of a separate piece of printed (or presented in any other form) assessment study which is particularly geared to engineering education and produced with the cooperative efforts of the ECBP and all of the mentioned higher education institutions.

To understand more of the teachers' understanding of the reasons or the perspectives that drove the engineering education reform which led them to accept and use the framework which was produced by ECBP, let's have a look to what a participant of this study had to say.

> *As far as I know, Adama, Addis Ababa University, Mekele University, and Bahir Dar University, conducted some workshop for about a week to discuss on the engineering curriculum and then Addis Ababa University, Mekele University worked out the draft curriculum and later they gave it to us with a CD. I know some advisors worked with them. I also heard that the framework has included the experiences of different countries such as Germany, India and the UK* (N.4: p.58).

This statement, in its first part, refers to a stage where the different institutions came together, probably to decide on who should take the lead in developing the curriculum, based on the framework which was already prepared. This response also makes visible that a framework was used as a source for developing the curriculum in the mentioned higher education institutions. The same statement, in addition, points out that there was some kind of influence from outside experiences. Whatever the case may be, ASTU, as an institution, at the end of the process at ECBP, received a soft copy of the curriculum (copied on CD) to make its task of adopting it and put it in such a way that it suits the institution. That has become the starting point for the curriculum development process within ASTU.

5.3.2. The curriculum Development Process within ASTU

The curriculum development process within ASTU, as pointed out by the interviewees of this particular study, has never stopped in one stance or two since its first beginning in the year 2007. It kept changing consistently and became unstable until recently. This is presented in the parts that follow.

5.3.2.1. The First Curriculum

Curriculum development within the context of ASTU began based on the curriculum that was developed and handed on to the institute in the form of a soft copy on a CD. The essence of curriculum development in this case then was a matter of adopting what had been received through the CD in such a way that it suits the particular situation. This was performed by establishing different departmental committees within the institution who would accomplish certain related tasks such as needs assessment and collection of relevant materials from different universities, as indicated by a participant of this study in the following.

> *To start with the curriculum development, in our part, we conducted some need assessment that included students and teachers the result of which was used as an input for the new curriculum. After we conducted the needs assessment, we went to Modjo for the actual curriculum development of the …program and worked there for about a week* (N.4: p. 60).

As new beginners of engineering education within the institution, teachers had to visit various engineering institutions to see and collect relevant course materials to use it as input for the curriculum. With all this in place, a retreat from the institution was made to produce the first draft of the curriculum and to make it ready for comments of different parties within the institution as well as by participants from outside. The curriculum developed in this process was then said to be "in the European Standard" though not explained what is meant by the "European Standard" and it could be different things, it was expressed by one of the participant of this study as follows:

> *…The curriculum was so national in its context, because it was produced by the Germans and Ethiopians and it was in the European standard mode in which the evaluation system, the credits were so different. It was in ECTS. The course content and everything was to the level of international standard* (N.9: p.172).

The curriculum, which was the first engineering education curriculum, in the history of the university, was commented nationally “by different intellectuals, industry owners, and by different people” (N.9: p.174) and it was sent to an Accreditation, Certification and Quality Assurance Institute (ACQUIN) receding in Germany for further comments (N.9: p.174). The curriculum, with further inputs from the institute, was again polished and organized in such a way that it could be implemented in the real teaching learning situation starting 2007/2008 academic year. But its service could not last long and was challenged soon after one year and subjected to a new change enforced by a new president appointed to the university. Nevertheless, students who were admitted to pursue their education as per the requirements of that curriculum were consistently attached to it and finished their undergraduate program.

An example of the structure of the first curriculum is depicted herein below for further understanding. It is an example from one department, but all engineering education programs produced at that time followed and used the same structure in their curriculum development. The structure of the first curriculum was a characteristic to only one field of study. Other fields of studies began their curriculum development with a structure similar to what is called the second curriculum herein below. The main difference between the two is that the first curriculum (which was peculiar to one field of study) did not have any stream or specialization at the undergraduate level while the rest of the fields of study incorporate stream, (sometimes called focus area, by some teachers).

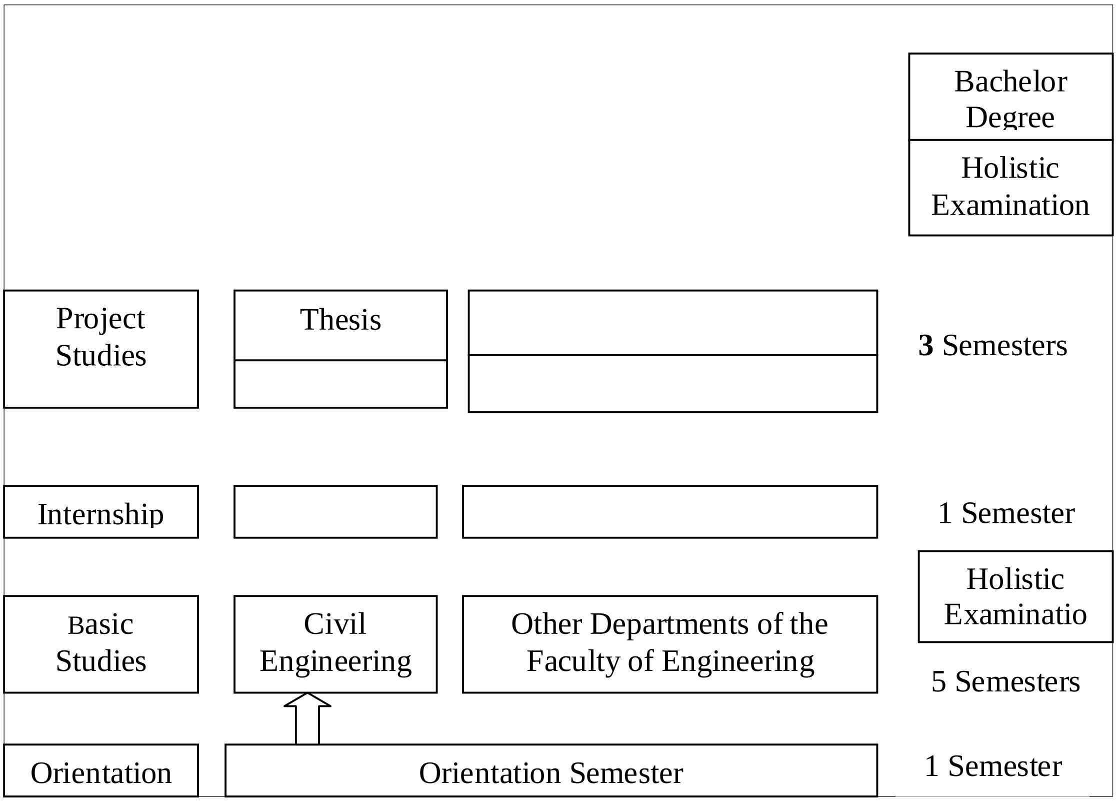


Figure 4. The First Curriculum

Source: Adama University (2007), Study Program for the Degree of Bachelor of Science (B.Sc.) in Civil Engineering.

The first curriculum, as the first experience of curriculum development within ASTU, which was accompanied by one year of implementation, did not leave much evidence behind it, in terms of the results it produced and in terms of the problems it might have encountered. Since it was implemented only once and had ceased after one year without proper review, no one would be in a position to tell its weaknesses and strengths either within ASTU or elsewhere. As per the participants of this study it was changed simply to implement the "New Framework" introduced by the then newly appointed "founder President" of the university.

5.3.2.2. The Second Curriculum

As it is pointed out above, the first curriculum did not serve longer with its original version. Soon after one year of its implementation it was challenged by a new change that was proposed by a newly appointed founder president of the university. Though he allowed the persistence of the then existing curriculum for a while, he eventually declared, in black and white, that Adama University (the present ASTU) would follow "the principles of the Bologna Process and the European Credit Transfer System (ECTS)" (Eichele, 2007: 45). The idea of using the European Credit Transfer System (ECTS) was part of the ECBP's framework and that was incorporated in the first curricula. But the President's ideas were more than using ECTS that included change in the structure of the established engineering education departments and the merging of departments to one another. This was stipulated vividly in his document entitled "Setting up Adama University – A Framework" (Eichele, 2007) and communicated to the staff. Inherent in this move of merging was the idea of strengthening the interdisciplinary nature of engineering education. Though this idea was not opposed officially for reasons unknown, it was clear that it did not please some of the instructors, especially those whose fields of studies became part of another field of study.

Secondly, the idea of streaming students in to some kind of specialization, after three years of common studies, was also not welcomed and supported by some of the instructors. The idea in that approach was that all students with the background of science, in their first entry to the university, learn the common courses together for one semester before they were granted admission to the engineering fields of study. Again after they were granted admission to the specific department of engineering, say Electrical Engineering, they all study the "core electrical courses" together for five semesters and depart to the specific focus areas such as Electrical Power Engineering, Control Engineering and others at the end of the third year. From there, they continue their study in the seventh semester and then they be exposed for internship in the eighth semester. Upon their return from their internship study they continue their study in their focus area for two more semesters until they finally graduate. An example of the structure of the second curriculum is shown on figure 6.

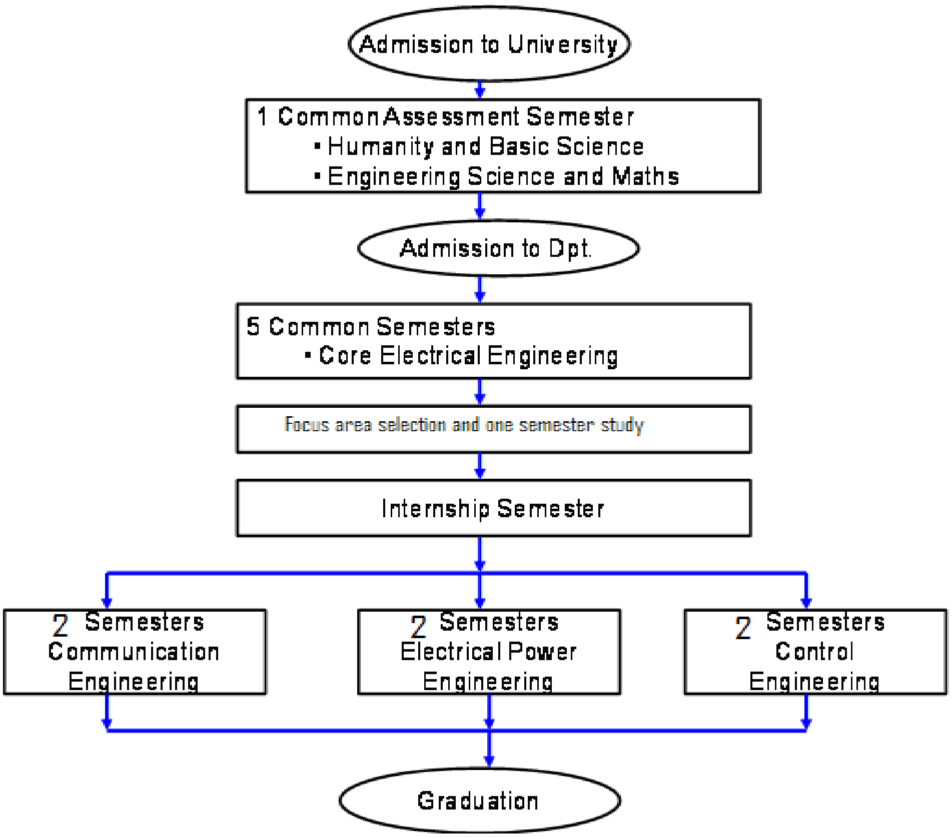


Figure 5. Example of the Structure of the Second Curriculum

Source: ASTU, (2009), Undergraduate curriculum (p. 4), Department of Electrical Engineering.

For some teachers the idea of the second curriculum approach was not acceptable because they thought that it would limit the students' understanding of the broad field of engineering that has to be learned before they opt for a narrow specialization which, in their view, has to come at the master's level. A view that reflected this discontentment was uttered by one of the participants of this study as follows:

> *…said at the first degree level you produce geotechnical engineer, transportation engineer, structural engineer, which is quite different from graduates of other universities and which is not acceptable in any context, like you know when they get into the work market, the company may need civil engineer and probably they (the company) may say "are you a civil engineer?". The graduates may say "yes". But they don't have that sort of degree. Their degree says they are geotechnical engineers, or they are structural engineers or transportation engineers which is different. So, we argued, in fact, that this is not the norm. …but … said, this is my proposal, as per my framework/Bologna. Yes that was it.* (N.9: p.178).

The teachers' concern with regard to the provision of a number of specializations at undergraduate level, that were proposed, at that point in time was not only a matter of sticking to the already existed ways of providing engineering education and the need to continue with it. What concerned them, as they say; it was the shortage and unavailability of qualified teachers in those newly proposed areas and the unavailability of laboratories and other materials necessary for teaching those specialized fields of studies at that point in time. They also had gone to the extent of proposing an alternative they considered suitable for the case at that point in time: This was expressed by one of the participant interviewees of this study as follows:

> *Ok, then, we proposed, if we have to continue, let us start and have students in two fields, i.e., structural and geotechnical engineering, because we thought for the other two, like hydraulic engineering and transportation engineering, we don't have good laboratory facilities, we don't have good trained specialists in that area in our staff, then we said we can't launch these programs. But for those two, geotechnical and structural engineering, we said we can launch. It was simply to satisfy his demand. But, we didn't win any trust in that proposal. Then we started the program as proposed by …* (N.9: p. 180).

Based on that new proposal, a changing many aspects of the previous curriculum was started. Some of the full-fledged departments (e.g., Surveying) were made to "migrate" to other departments and lost their status of a full-fledged department. Courses of the merged departments became part of the courses of the department into which they migrate. This totally resulted into a new curriculum system and modular rearrangements. While the first undergraduate engineering curriculum involved the acquisition of knowledge and skill in the various aspects of the specified field of engineering throughout until just prior to graduation, the newly proposed undergraduate engineering curriculum required a kind of specialization upon graduation. The previous curriculum was more of general type which encompassed bits and pieces of many areas of the specific field of engineering, while the changed one branched out into a number of streams (or focus areas) after the third year of students' learning.

In other words, the first undergraduate engineering curriculum tended to produce graduates that were more exposed to a variety of the specified field of engineering knowledge and skill with no or little depth in any one of the specific areas. On the other hand the later curriculum aimed at producing graduates with a sound general civil engineering base but who had a certain degree of specialization in one branch of the specified field of engineering. However, the degree awarded remained to be Bachelor of Science in engineering education all the way through.

The changes in the second curriculum, however, did not seriously affect the basic perspectives or the foundations on which the curriculum depended. Ideas such as the need for more practical orientation, the need for closing the gap between the competencies of graduates and what is needed by the industry, the orientation of using ECTS, the use of "internship" as a means for improving the practice of the students were still in place. But the difference in content of the two curricula was so significant to have a major impact on the final output (graduates), or in other words, in terms of the competencies students would possess upon their graduation. Some of the interviewed instructors do not see the second curriculum as distinct from the first curriculum in terms of the foundations upon which it rests. One of the interviewee in this study puts it as the following:

> *There were frequent changes of the curriculum in the past years. It may vary from one to the other. For example, if I consider the second curriculum and compare it with the first curriculum, there was a change in the course content in the form of some exclusion and some inclusions. It can actually be said it is the refined form of the first curriculum. For example, the mechanical engineering students who were enrolled in the year 2007 were supposed to be mechanical engineers with no specialization or with no focus area. But those who enrolled later and who were made to learn in accordance with the requirements of the second curriculum (who are now in 4^{th} and 3^{rd} year) are having focus area or a kind of specialization especially at their senior year* (N.6: p.106).

Though this was an example from one field of engineering, what actually happened was the same in the other fields of engineering as well. The implementation of different curricula within the same field of study for different batches of students was seen as problematic not only by the teachers, it was also shared by the students. For example, a student participant on a focus group discussion, carried as part of this study, puts the problem of the curriculum in connection with the teaching and learning as follows:

> *The problem with teaching learning is number one, because there is no stable curriculum. ASTU started to graduate engineering students only last year. The curriculum used for them was different from the curriculum of the present 4th year and 5th year students. The curriculum used for the present 2nd year and 3rd year students is also different from the mentioned two. Students who are in the 4th year and 5th year have the same curriculum. For example, we 3rd year*

students have taken common courses, that is, all engineering students; we don't specialize in anything; we don't have specialization (FG1[5]: p. 275).

From what is contained in this quotation it will not be difficult to understand the kind of uncertainties that could prevail among different batches of students within the same field of studies. Many educators and scholars, in general, agree that any change in curriculum has to be in place after the evaluation of the existing one. The practice of revising the curriculum at ASTU, however, does not witness anything like that. Change is a necessary thing in any sphere of life including institutions and programs, so it does in curriculum. But the change sought in this modern time requires a firm base to rest on and a kind of deliberate planning that considers various things such as the economic, social and cultural implications, if it had to succeed in its implementation.

5.3.2.3. The Third Curriculum

Attempts in revising the curriculum did not last with the first and the second revisions described herein above, a third attempt was also made by a founder dean of the School of Engineering. That curriculum revision, like the two mentioned above, did not deviate much in the basic perspective upon which it rested. The need for more practical orientation, the need for closing the gap between the competencies of graduates and the needs of industry, the orientation of using ECTS, the use of internship as a means for improving the practice of the students, were ideas still intact. But the difference here was the need for the inclusion of basic science and mathematics courses for first year students who joined engineering education. The assumption underlying this was that the students had deficiency in those subjects and then they had to be equipped with more of those subjects before they proceed and continue with the engineering subjects. Let us see how a participant of this study coined the different attempts made in revising engineering curriculum at ASTU:

[5] FG1 refers to location of the focus group discussion. Since there were three focus group discussions; one in each of the three sites, each are identified by letters FG and the site number into which the discussion was held followed by the paragraph number into which the quotation is found within the transcribed text. For example, (FG1. p.7) represents the focus group discussion held in site one and the quotation is found in paragraph 7 of the transcribed text.

> *Of course, five years back there was a basic reform in engineering curriculum to follow the German paradigm, and curriculum was developed by the ECBP along with MoE. In the case of Adama University, we used it only with one batch. And then on the arrival of a new president from Germany, he came with a new framework, and we started to revise the then existing curriculum to match with the ideas of the framework. Then we developed a new curriculum which lasted with two batches only. After the two batches again another dean came for us and he also came with his own approaches to add some courses during the foundation year assuming that the students are not capable of doing engineering education*. (N.5: p.79).

The third attempt of curriculum revision was also viewed by the same participant of this study, as it was an attempt that suppressed the employment of the government's policy which is connected to the transference of freshman courses such as physics and others to be learned at the preparatory level rather than at college level. This concern was expressed by the participant as the following:

> *This approach was, may be in contrary/or opposite of the country's belief. Because the country's belief is every graduate of the preparatory schools can join the university and do whatever is provided at the university level. So, due to that we struggled to divert, but we failed to convince, then we produced the curriculum. We now have two batches in that curriculum. Then that was the third curriculum including the ECBP curriculum.* (N.5: p.82).

In a similar way, another participant of the study identified and described the third attempt of the curriculum revision that took place at ASTU, as a "unique curriculum" to Adama Science and Technology University which was characterized by the inclusion of subjects that were supposed to be learned at the high school level. He said it as follows:

> *If we come to the 3rd curriculum the change was on the foundation courses. We actually call this curriculum a unique curriculum to our university. It was implemented only in our university. The essence in this curriculum was capacitating students who were coming to the university having different high school educational experiences and enroll to pursue engineering. The assumption that many of the students have deficiency in the subjects like mathematics, physics and other science courses led the inclusion of these subjects in the curriculum. It also included some general courses. So, courses which were supposed to be learned at high school level were included at the foundation year* (N.6: p.109).

What was apparent in all of those attempts of revising the curriculum was the absence of any evaluation or research results that detected the weakness or the strength of each of the approaches. This, as pointed out by the teacher participants of this study had caused uncomfortable situation to them as well as to students joining in different batches. As a result, each semester's course provision for the same level of different batches varied significantly to the extent of causing problem in scheduling and allocation of teachers for teaching the different courses. The frequent changes in the curriculum and the activities associated with it, by no means, was something supported by almost all of the teachers. Teachers were confronted with the activity of curriculum revision from time to time than to deal with the improvement of their teaching materials or involve in research work. One participant of this study describes it as the following.

> *The frequent curricula change hinders teachers from being certain, due to the frequent change of the curriculum. In addition, since teachers also involve in developing the curriculum, in many cases their time is occupied, which otherwise would have been used to improve their teaching methodologies and assessment activities* (N.3: p.42).

The concern in the curriculum is more of a concern on students' learning. Whether it is at primary, secondary or higher education level, talking about the curriculum refers to what teachers as teachers and students as students do, through their interaction within classrooms, workshops, laboratories accomplish. More specifically, it refers to the quality of the output, which is produced using a particular curriculum. The worth of a curriculum does not mainly lie on the quality of the document called "curriculum", but on the quality of the output that it produce. Frequent change in the curriculum in many ways has a repercussion that leaves a blemish in the thought and activities of both teachers and students and society as a whole.

5.3.2.4. The Fourth Curriculum: Modularization and Harmonization as a Means for Integration, Homogeny and Stabilization within ASTU

The curriculum revision practice of engineering education, which is taking place recently is oriented with and rests within the broad perspectives of the airborne terms of modularization and harmonization in Ethiopian higher education system. The newly introduced curriculum is not atypical to ASTU only. It is the result of a joint effort of a number of higher education leaders and teachers of universities organized under the support and leadership of the Higher Education Strategic Center (HESC) of the Ministry of Education within the country. The concept of modularization, as used in this curriculum, is directly related to the ways of organizing the content of an educational program. It involves the arrangement or clustering of related courses or topics of every engineering discipline into a definite segment for use by teachers and students in the teaching learning process within the institutions. An example of a modular arrangement extracted from a mechanical Engineering curriculum is shown on Table 6 for better understanding of what a module refers in the context of ASTU's curriculum development process.

Table 5. Modular Arrangement of Courses

Module No	Module Name	Course Title	Course No.	ECTS	Credit	Lec	Lab	Tut	HS
1	General Engineering Skill	General Engineering Skills		CP	Cr	Hr	Hr	Hr	Hr
			GeEng 1011	2	1	0	3	0	1
		Engineering Drawing	MEng 1011	6	3	2	0	3	7
		Introduction to Computing	IT 1011	5	3	2	0	3	5
		Research Methodology for Engineers	GEng 3011	2	2	2	0	0	2
2	Human and Social Science	Logic (reasoning skill)	Phill 101	3	3	3	0	0	3
		Introduction to Economics	Econ 101	3	3	3	0	0	3
		Civics and Ethics	CvEt 201	3	3	3	0	0	3

Source: ASTU (2011), Curriculum for Bachelor of Science Program in Mechanical Engineering, Mechanical & Vehicle Engineering Department, July 2011, p. 24

Some of the instructors do not seem to be comfortable in the application of the concept of modularization in engineering education. In relation with the current curriculum, one participant interviewee of this research described modularization as follows:

> *…if we look at the current curriculum, it possesses unique characteristics of harmonization and modularization. At the undergraduate level, we have seen the concept of modularization even in the past, but it was a bit difficult to implement it* (N.6: p.111).

Though modularization, as concept, is not new for the higher education system in Ethiopia, as pointed out by the participant in above, knowledge about the degree of its success or failure in its implementation in the context of the Ethiopian higher education system, so far, remains to be obscure and questionable.

As pointed out by some of the interviewees in this study, the other concept, intertwined with the concept of modularization, is harmonization. The concept of harmonization, in the context of the Ethiopian higher education seems to refer, on one hand, to the integration of the resources of higher education institutions that have similar programs with each other in terms of sharing academic resources, expertise, and experiences. On the other hand, it tends to foster the idea of the homogeny of engineering education programs or curricula and the specific courses within each program. As pointed out by an MoE expert who served as an interviewee in this particular study, "about 80 % of the content of each field of study is more or less similar for similar programs in all institutions, but the rest, 20% is left at the discretion of each institution to make its own adjustment in such a way that it suits the context into which it is implemented".

However, the state of homogeny within the essence of harmonized curriculum seemed to go deep to the extent of specifying the method of teaching and learning, the mechanism and the number of times each student has to be assessed for each course. This means any institute or teacher who offers, for example, civil engineering has to act and do as per the specified requirements of the modularized and harmonized curriculum. One of the participant interviewee in this study describes it as the following:

> *The features in the engineering curriculum are to be the same across the entire country. It is nationwide. The curriculum was modularized and harmonized. This included all the continuous assessment approach, the delivery methods, the learning outcomes, the graduate profiles with detailed description. I hope it is better than the engineering curricula we have seen before. And also the curriculum is intended to be more practical oriented than theoretical approach, even though there is a challenge with implementation of this practical activities due to the unavailability of sufficient laboratories or equipments, for testing and conducting lab work or practical activities* (N.5: p.84).

The teacher participants of this study do not believe that the harmonized curriculum has any problem. But they are skeptical for its proper implementation, especially in connection with the huge number of students they deal with in each of their classrooms or laboratories. However, harmonization in the case of ASTU, according to the instructors, is seen as a means for stabilization. It is regarded as a means for stabilizing the now and then changing attempt of curriculum revision, which they consider is unnecessary, waste of time and not comfortable for both students and teachers.

…I believe that this curriculum is better. Because the majority of those constructing and designing the curriculum are different expertise from different universities and these are involved in its construction. It is not developed on the bases of some individuals' or some institutions' interest. There are 31 institutions across the country, 8 of the mother institutions are the leading universities (N.5: p.76).

The value of modularization and harmonization, at ASTU appears to be more emphasized by the heads of departments and deans rather than the instructors. However, teachers, even the deans, including some department head themselves (even though they are promoting it), in many ways, seem to be skeptical about the applicability and effectiveness of the essence of modularization in engineering education. Their state of skepticism, in general seems to emanate from the nature and characteristics of engineering education itself which they say is difficult to implement modularization in engineering education.

ASTU, as a university is relatively young. Even though it had a considerable experience of providing technological subjects in the past, its experience in providing a full-fledged engineering program is very limited and is not more than six years. By the time it began the program the number of teachers who had a qualification beyond the B.Sc. level were very few. That kind of situation still persists, but this time it is with few more M.Scs and PhDs. The frequent attempts made in revising the curricula may be attributed partially to this lack of experienced and well qualified staff within the institution. Changing some parts of the curriculum is always an obvious thing that happens in every curriculum material to suit a particular context or a teaching leaning situation. But what has been seen at ASTU was beyond that which has gone to the extent of determining the type of graduate at the end. The following figure summarizes the process in general:

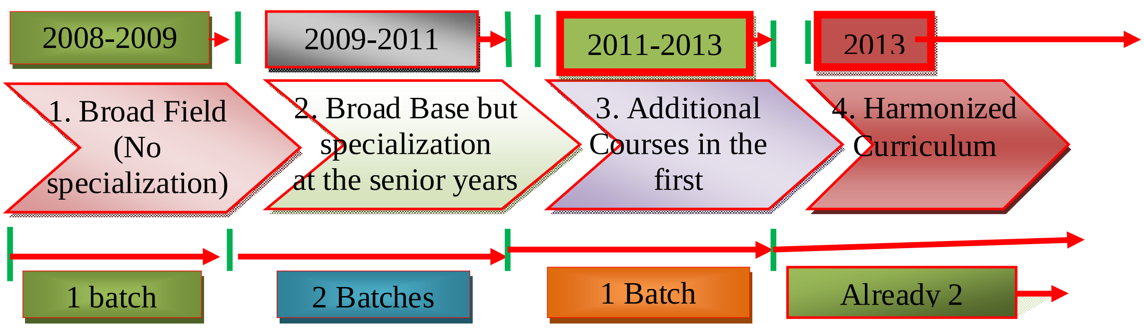


Figure 6. Summary of the different Curricula at ASTU

The variation in curriculum development at different moment did not result only in different kinds of curricula documents but also became a means for graduating engineers whose knowledge and skill varied upon their graduation. While all of the attempts do not deviate much from the base upon which the curriculum had to rest, much of the changes that occurred at different times in the short history of engineering education and its curriculum development tended to create a kind of uncertainty to teachers and students in a number of ways.

5.3.2.5. Teachers' Participation in Curriculum Development

Teachers at ASTU perceive that the initiative for curriculum development takes place without their knowledge and involvement. The different curricula change initiatives that are discussed in the preceding parts of this chapter were attributed either to an external body, notably ECBP, or to individuals who were posted in the leadership position. Though they agree that the curriculum in their subject area or field of study had to reflect the overall objectives of education of the country, they are also concerned about the now and then intervening curricular changes taking place within the institution. In spite of this ill filling, none of the participants in this study showed that their participation would have significant contribution on decisions of curriculum development. But they need to be aware and believe in it why changes are initiated and how it affects positively the teaching learning situation. It seems that they are more concerned on the availability of enabling situation such as the availability of teaching learning materials, machinery, tools and equipments. One of the participants in this study expressed his feelings about the importance placed on curriculum as follows:

> *Management gives too much attention to curriculum, but when it comes to the resources you have, you find it that curriculum is not a crucial problem. With moderately good curriculum and good facility, still we can achieve something good. Change with curriculum alone will not help the training. Equal emphasis, perhaps more emphasis should be given to the laboratory facilities and the development the staff* (N. 3: p. 45).

In fact this view is not directly an indicative of the importance and necessity of the teachers' participation in curriculum development. But it shows that problems of the teaching learning process in engineering education are associated more with the availability of sufficient and appropriate material including well trained teaching staff. This, however, does not mean that the concern about curriculum is not shown by the teachers. None of the participants have an objection to having good curriculum. Almost all of the participants felt that the first curriculum would have served better with minor changes rather than imposing a variety of changes with a short span of time. Though some of the participants put some importance on some of the curricula developed after the first one, most of them have preference to the earliest curriculum. The view expressed in the following quotation is an exemplar of this idea.

> *I personally believe that the ECBP curriculum was the best curriculum which has been number one; it was it was participatory when it was produced; industry, civil engineers, professors, and we were also members. I don't see disadvantage. It was well prepared, well done curriculum. It was the best curriculum* (N. 9: p. 185).

Contemporary curriculum scholarship places teachers in a central role in curriculum development, implementation and evaluation (Handler, 2010). The appropriateness and potential for successful role fulfillment by most teachers, however remains unclear and poorly supported. Researchers and scholars across the past decades have identified "limited engagement of teachers in meaningful decision-making (Handler, 2010: 32). This is an indicative of the teachers in many ways lacked to play a central role in curriculum development especially when it is associated with change.

5.3.3. Perceptions of the Field of Engineering Education and Curriculum

This part deals with teachers' perceptions of the concept of engineering curriculum. Teachers' perception of the engineering curriculum at ASTU appears to vary one from another. Perceptions of curriculum in general seem to fall into different categories. For instance, Fraser & Bosanquest (2006) identified four conceptions of curriculum, which are: the structure and content of a unit (subject), the structure and content of a program of study, the student's experience of learning, and a dynamic and interactive process of teaching and learning. The way teachers of ASTU perceived engineering curriculum, however, seems to be highly dependent on their perception of the purposes of the field of engineering and engineering education. For some of the teachers, engineering curriculum is perceived as a kind of plan which is intended to guide or direct students on what they have to do in their endeavor of learning. For others engineering curriculum is a means by which a country produces engineers who are capable of solving prevailing problems. The third type of perception held by teachers was seeing the curriculum as a means of producing students who are capable of doing things by themselves and who can be creative in the field they are trained. Each of these is treated in the following parts.

5.3.3.1. Engineering Curriculum as a Plan for Students' Learning

Engineering curriculum is perceived by some of the teachers as a kind of plan which is intended to guide or direct students on what they have to do in their endeavor of learning. Such teachers perceive engineering as a field to be studied in depth until one reaches the highest level possible. So the purpose of engineering education is to help students acquire the highest level of engineering knowledge through step-by-step provision of engineering sciences until they reach the highest level. Therefore, engineering curriculum is seen as a means by which students are helped as they go through their learning of engineering sciences. It mainly focuses on meeting the needs of the students. Though said it in different arrangement of words by different teachers, a view of an interviewee which represents this perception of the curriculum reads as follows:

> *In general engineering curriculum is a type of curriculum which directs or makes students towards the … engineering science fundamental concepts at the initial level. Then it grows up from the fundamentals to the specific level which directs them to the specialized direction* (N.2: p.21).

As can be observed from the above quotation, the focus in such perception of engineering curriculum is on the students' acquisition of the subject matter which is related to fundamental concepts of engineering science and which, finally has to develop to the level of specialization. An orientation to such kind of curriculum and its implementation implies the production of engineers who are highly qualified in the engineering sciences rather than in the engineering practices. Another example of such perception of a participant also reads as follows.

> *Students have to be strong enough in mathematics and physics. It demands it badly. I tell you a student who has weak concept of physics and mathematics can never be an engineer* (N.9: p. 2003).

5.3.3.2. Engineering Curriculum as a Means for Full-filling the Country's Objectives

A second type of perception of the curriculum that was reflected by participant teachers at ASTU was a perception that is described in association with what engineers have to do for society or the country, especially in connection to the ability of solving prevailing problems and making society's life better. Such perception assumes a "pragmatic" view which focuses on the practical use of curriculum. Curriculum development in such a case requires close interaction with local practice and those who actually use it. For teachers who hold this perception of engineering education, engineering curriculum is a means by which a country or a community prepares those engineers who would be capable of solving prevailing problems and make society's life better. An exemplar representation of such perception reflected by one of the teacher participants reads as follows:

> *Actually curriculum is devised to make students to achieve the objective or the need of the country In engineering case curriculum is implemented to prepare youngsters to be skilled and knowledgeable people based on current technology* (N.1: p. 1)

Here the focus is on producing students who are capable of acquiring both engineering skill and knowledge and be capable of achieving the needs of the country. The emphasis in such perception of curriculum is on what a young person has to do to the society after the completion of his/her learning, not more of the learning of engineering sciences in depth and proceeding in that way up to specialization. Such orientation to curriculum presumes the attainment of a pre-specified need through providing engineering education to students. However, the acquisition of knowledge, skill and acquaintance with the current technology is part of the focus for students learning.

5.3.3.3. Engineering Curriculum as a Means for Creating Engineers who are Critical Thinkers and Capable of Doing Things by Themselves

Some teachers perceived engineering curriculum as a means for producing engineers who are capable of doing things by themselves and can be creative in the field they are trained. This perception of curriculum is different from what we have seen above in this study. The focus here is on the students' capability of doing things by themselves which may be associated with their attitude and self determination. One such perception of engineering curriculum which was provided by one of the participants of this study reads as follows:

> *The essence contained in the curriculum is producing graduates that are capable of doing things by themselves and who can be creative in the field they are trained* (N.4: p. 71).

An elaborated version of the same perception that is related to an individual's capability and the details of what he/she do as an engineer is provided by another participant as follows:

> As an engineer, one has to have a broader view of engineering than doing things right. because, an engineer often has to supervise technicians and technologists and the engineer's supervision on work is so important, as an engineer, one has to have good knowledge of science, the basic background and it is important to make good balance actually, an engineer should not be theoretician, or he/she should not be a mare skillful person who only knows how to guide, how to bend and fix that. As an engineer, he/she is expected to be a master of the basic science, and the skill as well. He/she must do and must also get nothing done by the technician often you encounter the problem (N.3: p. 39).

The expectation in such kind of curriculum orientation is the production of a versatile and capable person who should fit into doing a variety of things including the management of some work forces at a certain level.

5.3.4. The Content of Engineering Curriculum

It has been discussed earlier in this chapter, that teachers perceive curriculum in different ways. The way teachers perceive curriculum obviously entails a difference on the type of content they select to teach their students and the methods they use in their teaching of the subjects. What is discussed herein below, in a way, can be regarded as an extension and elaboration of those perceptions of curriculum, but this time with emphasis on content. The response of teachers with regard to content was assumed within a broad question of "what do you think is important in engineering education for the students to be successful?" and how do you make it happen?" It was intended to identify the skills, knowledge and experiences that are regarded as important by the teachers for students' learning and what mechanisms they use to make students successful. It was also meant to prompt and identify on what teachers emphasize in their teaching for making students' learning meaningful and useful. Therefore, included in the part below are: expectations of curricula, knowledge and skill base, content as a means of achieving the country's objectives, and professional and personal attributes.

5.3.4.1. Expectations of Curricula

In analyzing the curricula documents in ASTU, the content of engineering education is claimed to be organized in such a way that it creates ability to: apply knowledge of mathematics, science and engineering, design and conduct experiments, as well as to analyze and interpret data, function on multi-disciplinary teams, identify, formulate, analyze, and solve engineering problems, including ability to communicate effectively and understanding of professional and ethical responsibility in the students (ASTU, 2007). To make this true courses are organized in modular arrangements of various categories. A Module is defined as an arrangement of "a set of related courses" (ASTU, 2007: 12). For instance, one of the departments categorizes courses as: General Engineering Skill Module, Basic Science Modules such as Applied Mathematics and Advanced Mathematics Modules, Humanities and Social Module, Communication and Entrepreneurship Module, Core Engineering Sciences Modules: Workshop Technology, Computer Aided Drafting and Machine Drawing, Engineering Mechanics, Mechanics of Materials, Advanced Mechanics, Material Science and Machine Elements and Supportive Modules (ASTU, 2011). Likewise, the other department categorizes the courses as General Science & Engineering, Social Sciences, Communication & Humanities and Surveying modules.

More specifically, the curricula documents suggest that content of engineering education is defined in relation to the competencies identified to enable engineering students to understand and be able to do the things they have to do. This means that the content of engineering education has to focus mainly and be structured around knowledge and skill bases that would enable the students to apply them to a pre-specified ends. This, in the context of this study, means the knowledge and skill that is learned by the students has to be able to create their own profile as specified by the curriculum; not as they would like it to be. This however, does not mean that all the content specified in the curriculum does not contribute to what they would like to be. The mathematical and engineering sciences provided to engineers come from the same root wherever the country may be. What varies most is the degree of concentration and the way it is provided, that is, the availability of materials, the qualification of teachers, the technology used for teaching, and the commitment of the leadership in introducing and enforcing quality boosting ideas.

5.3.4.2. Content as Knowledge and Skill Base

As it has been discussed earlier in this chapter, teachers' perception of engineering curriculum varies in a number of ways. Three such varied perceptions were identified and discussed. Likewise, engineering teachers' perception of content appears to vary considerably and aligned with their view of engineering curriculum. For those who viewed engineering curriculum as "a plan for student's learning of the field in-depth", the purpose of content is to enable students to have deep knowledge and analytic skill with reference to the particular field of study, which is engineering in this case. The major focus of such a view is on creating students who are highly knowledgeable and skill-full in the art of analyzing engineering and other related sciences including mathematics. Even though the provision of academic knowledge and skills could be supported by some type of activities, the aim obviously is to enrich the students' acquisition of that knowledge and skill rather than focusing on the application of knowledge and skill in a rather novel situation and solve practical problem. An example of a response of a participant that reflects such a view of content reads as follows:

> *Students, to be successful, there has to be a good balance of science and mathematics. If a student has to be successful in engineering he/she has to have good background of physics and mathematics. In addition, he/she has to be good in communication skills which include written, verbal, or graphic communications. Most importantly, good views of points to communicate ones ideas around different professionals in the field of engineering* (N. 3: p.48).

In this quotation no mention has been made about the necessity of practical skills. Though it is impossible to guess what is in the mid of this participant one can understand from the responses that the emphasis is more on theoretical aspects than the practical skills.

5.3.4.3. Content as a Means of Achieving the Country's Objectives

For those who viewed engineering curriculum as "a means for full-filling the country's objectives", the perception of content seems to refer to selection. The focus, in this regard, is on selecting content and skills that would enable students to perform the pre-specified competencies and attain the goals set in the curriculum. This means, that student' learning of content by itself is not the focus of teaching and learning. Content learning has to contribute, support and develop the students' ability of solving problems through performing the competencies specified. Moreover, teachers who hold this view believe that teaching has to incorporate more practical activities than students' learning of content from the books but worried because of their inability to do that due to causal problems eminent in the institution. Let us see how such a problem is expressed by one of the participants of this study:

> *The condition, at present, is not suitable for providing more practical skills as we wish it to be. For instance the current population of students is not convenient, not comparable with the equipment and the practical working available. With the assumption of providing practical skills which is directly related to work, we have a program of internship for one semester. But it doesn't still meet out target* (N. 1: p.7).

In this regard more focus is needed on students' acquiring of more practical skills than that of the sciences and mathematics unlike the discussion expressed above. Another participant also expresses his worries as the following.

> *Of course, to be a good engineer one has to be in laboratories rather than in the classroom and be a theoretician. But due several constraints we are not capable of doing that. That is why our students are wasting more of their time in classrooms trying to understand theories* (N. 5: p. 88).

5.3.4.4. Content for Creating Engineers who are Critical Thinkers and Capable of Doing Things by Themselves

For those who view engineering curriculum as "a means for creating engineers who are critical thinkers and capable of doing things by themselves", content is seen as a means by which students become familiar with the available resources and possibilities that would enable them to tackle engineering problems and to have new insights during their learning. Such teachers are concerned to strike a balance between what a student wants and what industry needs. An attempt of such focus, on one hand, is an attempt of addressing the need for human resource development and on the other hand it instills confidence in the students themselves. So, the use of content in this sense is to build the knowledge and skill of the student so that he/she will do the work required and to be confident enough in what he/she has to do as an engineer. Let us see what a respondent of this study had to say in this regard:

> *Students want to fit into the realities of the work outside. Hence, they need more practical skill that makes them fit. On the other side industry needs graduates who have more practical orientation to do the job without expecting additional training. We, as teachers, also need to provide engineering education that is suitable for both students and industry. Anything we teach outside the need of the two parties mentioned is simply an academic exercise* (N. 4: p.70).

A prospective such as this one from the side of teachers entails their need for careful planning and selection of content to meet the demands of both students and industry and to build the confidence of the students as well. Seen together, engineering teachers, however, do not seem to embrace the modular arrangement of courses on the ground that the engineering education by itself has an interdisciplinary nature which calls for an interrupted teaching learning process which would be difficult for modular arrangement. Even though teachers have to implement modular arrangements in their courses it is not without resistance.

> *Even though this modular approach is ahead with other university level education, it is communicated to engineering or technology faculties of the schools of engineering, but the implementation is a little difficult, so there is resistance already (*N. 5: 84).

5.3.6. Teaching and Learning: The Interface between Engineering Education Curriculum and Engineering Education Practice

Teaching and learning in this study is taken as the interface between the intentions of the curriculum and the real practice of teachers and students at the institution level within the classroom or workshop situation as described by stakeholders. Hence, included in this part are the practice of teaching in ASTU, student’s learning, the practice of internship and assessment.

The term implementation is a common word that is always attached with the execution of a newly developed or a revised plan. The practice of curriculum implementation involves varied institutional settings, several hundred or more teachers in each of the institutions, and hundreds or thousands of students depending on the size of the educational setting where it is practiced.

There is no guarantee that institutional settings of the same level and the same status could implement the curriculum alike. Implementation of the same curriculum at different settings could yield different results in terms of, if not in quantity, but terms of the quality anticipated and sought in the curriculum document. The reason for the differences may come from different sources such as that of the condition of the physical setting of the institution into which the curriculum is executed, the capacity, motivation, and qualification of teachers involved in executing the curriculum, the availability and sufficiency of physical and material resources necessary for executing the curriculum, and the quality of leadership in the particular institutional setting.

The starting and the culminating point for implementing a curriculum, however, is the process known as teaching and learning which involves teachers at one side and students on the other side.

5.3.6.1. Engineering Teaching at ASTU

Teaching, expressed in terms of what the teacher does, take place either in classrooms or within the workshops or laboratories in the case of engineering. Likewise, learning, expressed in terms of what the students do, takes place in various locations, in addition to classrooms, workshops, or laboratories.

When we talk about the process of teaching and learning in this study, we refer to the interactions between the teacher and students and the material with or about which the communication is made. The teacher's role within the teaching learning process includes the preparation and delivery of new ideas and materials that can assist student's learning. On the other hand students are the ones who are expected to gain knowledge and skill from such communication. The successful implementation of any curriculum then presupposes the synchrony between these elements and results into what is called quality teaching and learning. Quality teaching in higher education matters for student learning outcomes. But fostering quality teaching presents higher education institutions with a range of challenges at time when curriculum keeps frequently changing and remains unstable as witnessed at ASTU.

As it has been pointed out in the preceding parts of this study, ASTU has experiences of frequent curriculum development practices that resulted in different curricula at different times within this short time range of the existence of engineering education in the institute. The execution and effectiveness of such curricula also depends on the agreement and synchrony between what is taught in the classrooms, laboratories, and workshops and what is known by the students. In other ways this refers to the congruency between what was planned and what is learned by the students.

The way teachers perceive curriculum and content affects their teaching and ultimately the students' learning. The teaching learning process in engineering education at ASTU refers to the teaching learning of courses arranged in modules. Engineering education includes different modules from different disciplines such as that of the humanities and social sciences, Business, and others, in addition to the major and related engineering discipline modules. While the teaching learning processes of the humanities and the social sciences, including business and the theoretical aspects of engineering modules mainly depend on the interaction between the teachers and students at classroom situation in the form of a lecture, the core modules of the engineering disciplines in most cases require the use of workshops and laboratories more than others.

Although the usefulness of other teaching strategies is being widely examined today, as pointed out by the participant of this study, the lecture still remains an important way to communicate with the large number of students (ranging from 70 to 80 students in a class) at ASTU. The traditional lecture method, if used in conjunction with active teaching strategies can be an effective way of teaching and to achieve instructional goals. However, engineering teachers at ASTU do not seem comfortable with the present arrangement of the class size for lecture method. For example, a response from one participant of this study points out the distress related to large class, as follows:

> *Teaching and learning is poor because of different constraints in materials and resources in general. Materials are not sufficient compared to the large number of students assigned in each group. The number of students in a lecture group is too many; 60 to 70 students per lecture class and 30 to 35 students per lab session. Seats in the classroom are not comfortable. Students in both lecture and lab sessions are very crowded, and hence, checking each student's work and progress is very difficult and tiresome, if not impossible* (N.2: p.29).

Another fellow teacher who is a participant of this study also iterates the problem associated with large group of students as follows:

> *The student population is too big. For instance, one lab group contains 40 students and one lecture group up to 70 to 80 students. You can not follow each student, even in the lab work because of the big size of student in a group and because of the shortage of the supply and equipment. … In addition to this, the attitude of the students is also very difficult to handle* (N.1: p.15).

From both of the above quotations it would be possible to understand what kind of teaching would exist in both lecture classes and in lab sessions of ASTU. It is not also difficult to guess what a classroom with 80 students would look like and the seat arrangement therein. It clearly suggests that there is a wide distance between the teacher and student in terms of what the teacher does to each student and in terms of what each student has to receive from the teacher. The points expressed by one of the interviewees in the quotation below, is an indicative of the situation into which teachers as teachers act and students as students learn. It is also an indicative of how assignments are used in the teaching learning processes. Assignments as a teaching learning process, as used in this case remains to be the work of the students alone that avoids the feedback element that has to be done by the teacher.

> *For instance, when I teach second and third year students, usually they are many in number, 60 to 65 in a class and sometimes 70. Even if I tried to give them assignments I hardly have time to correct the papers and evaluate them. I give them assignments often not to evaluate them but to make them work. My assumption in doing so is that they will study by the time they try to work the assignment. And finally, I collect the assignments; frankly speaking, I don't get time to correct all those 70 papers of each section. So, I have to pile them up in my room and at the end of the semester I have to throw it away* (N.3: p.51).

Teachers in the engineering education appreciate and believe in the use and the inevitability of the lecture method in the teaching learning process. But they think that the large number of students assigned in each of the lecture classes has slackened their relationship with their students, especially when they have to teach two or three groups of such a class. They give assignments to the students but they don't give any feedback to the students due to the large number of students they teach. In such a case teaching becomes like throwing whatever you have to students and there is no way that you know whether the student participates and learn in a meaningful way other than listening to what the teacher says and learning whatever material is provided to pass the examination. If we say that engineers have to have an ability of translating the knowledge and skill they have learned into solving a problem of practical nature, a heavy reliance on the traditional lecture method involving a large number of students would not result into having the kind of engineers one would like to have. As pointed out by Felder and Henriques (1995), students learn by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing. The nature of the lecture method of teaching usually deals more with one way communication and the imparting of knowledge aspect rather than translating knowledge into practice and applying it to problem solving.

Another method employed in the teaching learning process of engineering education at ASTU is project method. It is believed that the employment of this method would equip students with the ability and understanding of the process of planning and executing a project. As one of the participant teachers in this study puts it, the need for employing such practical method arises from the need of equipping students with what they need to meet at the final end.

> *Students want to fit to the realities of the world of work. Hence, they need more practical skill that makes them fit. On the other side industry needs graduates who have more practical orientation to do the job without expecting additional training. We, as teachers also need to provide engineering education that is suitable for both students and industry. Anything we teach outside the need of the two parties mentioned, it simply be an academic exercise which does not serve the immediate development need of human resource within the country* (N.4: p. 69).

The project method of teaching requires the teacher to prepare or design a project that has to be performed by the students within a certain period of time. Students have to work on a project that has relevance to the course they learn. It requires the use of workshop practices, materials, tools and equipments for its employment. The success of a project approach as teaching learning method in engineering education is highly dependent on the availability of the materials, tools and equipments, but it is not without challenges of its own within ASTU. Let us see what a participant of this study on the interview has to say with regard to this:

> *The condition, at present, is not suitable for providing more of practical skills as we wish it to be. For instance, the current population of students is not convenient (not comparable with the equipment available and the practical working space available* (N.1: p.7).

This sense of trepidation is shared by almost all the teachers who were participants in this study. To have more understanding of how problematic the situation is, let us see what another participant of this study had to say:

> *The students actually want to know how courses learned in theory could work in practice. However, due to the scarcity of resources occurring in the department, they have no option, rather than accepting the existing situation and continue with that* (N.7: p.142).

The possibility of creating practical oriented graduate largely depends on the students' involvement in repeated and varied practical work. For example, telling the step-by-step procedures of driving a car would give a theoretical knowledge, but it alone would not enable an individual to drive a car. If he/she had to drive a car, he/she has to practice it twice or three times or more. The inclination towards the provision of more theory with less practical tasks in the teaching learning process of ASTU has also been felt by students who were participants of a focus group discussion that was organized by this researcher. This reads as follows:

> *The teaching learning process is too theoretical; I don't think engineering has to be theoretical. But we are learning theory; this is one of the weaknesses of the teaching learning process* (FG1: p. 220).

Neither the teachers nor the students deny that the teaching learning is biased towards theory and this is contrary to what is indicated in all curricula documents defined under the auspices of ASTU so far (see for example, AU, 2007a: 5-7; AU, 2007b: 10). Let us also see what another focus group participant of this study had to say in the following quotation.

> *The other is laboratory problem; we didn't work many of the labs we were supposed to do; For example we did not work hydraulics lab; There is an existing soil lab, but on the reason of not having the accessories and materials it is not working; Even when there is the material and we are supposed to work the laboratory, due to the large number of students we cannot work the lab as it is supposed to be. At present we were supposed to work a lab (soil test) on highway course; but what happened was after we have taken about three classes, we were told simply to write a report*

and we did it. We did not perform the lab based on the procedure. Now, if I am asked about the test it is hard to say that I have the knowledge required (FG1: p.233).

5.3.6.2. Internship as a Teaching Mechanism

Internship, as one component, is part of the engineering curriculum at ASTU. Students who have completed their three years of study go out of campus for one semester internship practice within the industries available in the surrounding. Participants of this study, that is, both teachers and students including those interviewees from industry agree that internship as a teaching learning mechanism is an indispensible component for students' learning. All of them agree that internship would give students the opportunity to look into what is contained in the world of work and to have a feeling of practice within it. Some of the teachers, as well as students, also see the act of internship as an important means of filling the gap between what is provided within the campus study and what is prevailing in the actual practice of work situation. Nevertheless, it is not without problems of its own. As pointed out by some of the teachers one of the major problems is unavailability of industries that can accommodate all of the students legible for internship practice. Even if students are assigned on internship practice within an industry, at times it fails to meet the intention due to lack of proper supervision and follow-up from the side of the institution which from the side of teachers.

5.3.6.3. Assessment and Evaluation

Assessment in the engineering education of ASTU takes place in different ways and for different purposes. The dominant part of assessment until recently was the pencil and paper method where students are required to respond to teacher made questions in written forms. Participants in this study witness that continuous assessment has become mandatory more recently. While they appreciate the importance of continuous assessment ideally, they express that it is intertwined with full of problems. Much of the claim is related to the high number of students joining each of the departments every year and every semester. Neither the teachers nor the students at ASTU regard the practice of assessment as efficient and effective. Both teachers and students think that the assessment mechanism needs some kind of improvement.

The following statement of a department head who is a participant of this study shows the ill feeling that characterizes the feelings of many of the participant teachers who are involved in this study. “In conclusion I can’t say effective continuous assessment is conducted, but we are trying our best” (N. 6: 105). One of the most serious problem teachers raise here is the number of students in each group of class and the teachers’ involvement in teaching a number of group. Teachers are required to teach 12 credit hours per semester which means 12 hours class contact per week. For example, if we say that a teacher is involved in teaching a three credit hour course for different group of students, and if we say each group has 70 students, the number of students he/she would be dealing with would be 12 /3 x 70 = 280 students. As a teacher he/she has to teach 280 students, he/she is required to implement continuous assessment (as some indicated six times/semester/course) for each group, he/she has to prepare examinations, He/she is expected to mark all the examination papers and give feedback to all of the students.

Such conditions, as witnessed by the participant teachers, are practically difficult. As expressed by them, they are not left with any time to accomplish all these as required. Hence, a short way out is officially accepting everything and practically not doing it up to the requirement of the curriculum or not at all doing it. Let us see how this was expressed by a participant of this study, which is also shared by other participants as well:

> *I don’t think people are doing it (referring to assessment) well. Except speaking theoretically that we are practicing continuous assessment. Personally, it is not well done, because of the large number of students. We cannot evaluate their papers; you cannot see every student’s performance every time you come to class. It is not simple* (N. 9: p. 208).

Student assessment is the mechanism by which you gauge the student’s ability of knowledge and their ability of doing engineering tasks upon their graduation. A sub-standard teaching, as stated in this study elsewhere, accompanied, with a sub-standard assessment mechanism is obviously a threat for the quality of education, and subsequently on the quality of knowledge and skill graduate engineers acquire. None of the respondent teachers felt that they are practicing the assessment mechanisms specified in the curriculum document are practiced properly. The same ill-feeling of the assessment mechanism is also felt by the students. As witnessed by the students, both teachers and students are more exam oriented, which means teachers give examination just to fulfill the official requirements and students take examination just to pass. Suppose we see the following statements of students which were uttered on a focus group discussion, we can understand how quality is being threatened: We present three of them here for more understanding of the problem:

> *They (referring to teachers) try to examine what the students do not know. They target deliberately on what the students do not know; they are more concerned on the question of "what is that the students do not know" rather than what is known by the students. to my understanding the essence of an examination is what have I done to my students and what have the students gain from what I did to them; but what we see is just because he/she has mentioned a topic, he/she ends up to use it as an item for examination* (FG. 1: p. 285).

Though this was said in relation to some of the activities of some teachers, students are also critical of themselves in terms of how they react to examinations and tests:

> *I explain the teaching learning process as dependent on grade. If you say 'why?' when we come to teachers, teachers say to us "this portion will not be included in your examination; you don't have to read it. We as students do not want to read anything that may not be covered by the examination. In this university the major objective is obtaining grade rather than the acquisition of knowledge and skill* (FG. 1: p. 224, p. 225).

Students are also critical of the institution's management in connection to what teachers do in relation to their act of examination.

> *I don't think that the management is supervising teachers and check who is doing what; some teachers, after having class only two times they will examine us mid-semester examination; in the same way, after the mid-semester exam they teach us two times and examine us final examination. Since we students are grade oriented, we don't accuse the teacher and try why it is going like that, because we think that the teacher will punish us in grades (FG. 1: p. 226; p. 227).*

5.3.7. The Challenges of Engineering Curriculum Implementation in ASTU

In this part, the focus is on what participants frequently mentioned as challenge in their experience of teaching learning. Frequent curriculum revision, teacher quantity and quality, student population and budget and resources are referred to as challenges.

5.3.7.1. Frequent Curriculum Revision

Change is an inevitable phenomenon of everything. Nothing remains stagnant forever. So does the curriculum. But curriculum to be changed has to pass the test of practice and time. In the first place, curriculum change and implementation cannot and should not be a matter of an individual's or anyone's choice or preference. It requires the involvement of a number of stakeholders; policy makers, institutional leaders, teachers, students, and others who have their own stake to share and contribute towards its effectiveness. However, the repeated practice of revising the engineering curricula at ASTU has left the teachers and students with constant uncertainties and they put it among the major challenges. Almost all participants of this study expressed their concern that the frequent act of changing curricula has created uncomfortable situation for both students and teachers. An example of that concern which was uttered by a respondent reads as follows:

> *The frequent curricula change hinders teachers from being certain. Moreover, since teachers involve in curriculum revision activities, in many cases their time is occupied which otherwise could be used to improve their teaching methodologies and assessment activities* (N.3:p. 57).

Some of the teachers, as it has been mentioned in the preceding parts of this study, see the last curriculum as means for stopping the recurring activity of curriculum revision which was common in the last few years. Of course, the nature of engineering education in this era is changing fast due to the demands coming from diverse situation but not as fast as the changes of curriculum in ASTU.

5.3.7.2. Teacher Quantity and Quality

Many of the participant teachers in this study believe that their teaching is not up to standard and attribute that to the shortage of resources, the large number of students, and the poor academic backgrounds students have. But few of them were willing to look into themselves and say what they feel and do as teachers. A most appealing example of such an insight which is said by a participant teacher in this study, reads as follows:

> *A graduate engineer, just like me, will be paid about thirty thousand Ethiopian birr in the industry. Me, a graduate engineer, I am paid 3700 Birr as an experienced lecturer. Why should I waste my time in the institute teaching students? Rather, I should go to the industry and get thirty thousand Birr. What I mean is you know if you want to improve engineering education you have to*

> *improve the salary of engineers who are supposed to teach these candidate engineers. Otherwise, if you pay me little money I pay little time for students, because I have to work outside to earn more money* (N. 9: 2001)

Though this was said explicitly by this participant, which, may be a bit exaggerated, it appears to be true in other cases too. This is also evident in what students say with regard to the type of teaching they are receiving. Students who participated in the focus group discussion witness that many of the teachers do not appear in their every day class sessions and try to teach the subjects they are assigned to teach. According to these students a significant number of the teachers either get absent from classes, or even if they come to classes they do not teach the subjects up to the expectations. Since such occurrence is more visible on the teaching learning sessions of the core or major subjects, students felt that they are denied the right to finish the specified course elements properly. An expressive example of such discontent uttered by a focus group participant student reads as follows.

> *It cannot be said that the instructors are providing us the required education and skill as appropriate as per the requirements; the reason for this is what I stated previously; many of the instructors are working in the cities. For an instructor who has a class on Monday, no one can be sure for his appearance on Monday. A number of instructors are not teaching students as per the schedule. Due to this, it cannot be said that teachers are in the state of producing and delivering knowledge and skill that the student is supposed to get* (FG. 1: p.216).

Engineering knowledge, skill, and abilities, that is expected from anyone who has gone through engineering education comes partly as the result of what the teacher does in classrooms or in workshops during his/her teaching. Though students are inherently capable of constructing their own knowledge, skill and attitude, they need to have a professional support, guidance and facilitation of the teacher. On top of all the materials available in their surrounding within their institution, they need to be taught properly as per the requirements of the course outlines and course descriptions. But this seems to be highly jeopardized due to teacher absenteeism and this puts the quality of engineering education to be threatened.

Participant students also raised the problem of some teacher qualification and their incapability of teaching the subjects in relation to its practical application. According to the students what they are being taught is more of theory rather than theory in association with practice. The following statement of a participant student is an indicative of the experiences students have:

> *The teaching learning process is too theoretical; I don't think engineering has to be theoretical. But we are learning theory; this is then one of the weaknesses of the teaching learning process; the other is the incapability of many of the teachers in practical work. In fact, students are not the examiners of teachers. There is a legal body responsible for that, but they are also affected by flow of the tradition of teaching and learning. He said in Amharic* "c፡¨ `É c፡ª [É ¾S × ¾S T ` T e ƒ T ` ዘ\ዩƒ" (FG. 1: 220).

Upon further quest for more explanation on what he meant by this, he explained what he meant by this as the following: "The teachers previously learned theory without the support of laboratory and related practical experiences and then they are teaching us without the support of laboratories just as they were taught previously" (FG. 1: 221).

Even though the majority of the participant teachers in this study attribute the problem of teaching to factors such as shortage of resources and to the large number of students they teach at each session, teacher absenteeism coupled with improper execution of teaching has become a threat to the quality of engineering education at ASTU. If ASTUs vision of becoming of "a first choice in Ethiopia" has to be realized and if it has to accomplish its mission as planned properly, paying a closer attention to such problems and solving it as early as possible seems to be an inevitable task awaiting.

5.3.7.3. Student Population

The class size for the first year lecture classes is stipulated to be 60 to 80 in ASTU. (Senate Legislation, 2012: 171). Likewise the lecture class size for second year and above is indicated to be 50 to 65. Class sizes for tutorial and lab teaching is also pointed out to be 30-40 and 20-30 respectively. This is not different from the number that is pointed out by the participants of this study in reality. But they thing that teaching so many students in a class and dealing with many groups of such a class leaves the teacher to run out of time for his/her preparation and for providing feedback to students regarding their group work and individual assignments and other works. Such an ill-feeling of teachers is manifested not only in connection with their teaching but also with their duty of student assessment. The following statement said by one of the participant of this study shows what it looks like:

> *I have no time to practice continuous assessment, I have no time just to offer them project and I have no time just to evaluate it. This means we are not properly assessing or evaluating students, because their number is so large. We have no time even to prepare for the course to offer a lecture in class* (No. 9:2007).

The problem with high number of students was also a concern of the participant students in this study. They feel that the size of their number in both classrooms and in workshops has an effect on their learning. One example of such worry by the students reads as follows:

> *This school is accepting students beyond its capacity. Now 20 students learn on a table that was originally made for 2 students. When it was a technical school 2 students were doing on a table, but now we are using it for 20 students. Now we use one model for 20. In this, one of the students gets grip of it and touches it and looks how it works, the 19 of us simply stand around and watch* (FG. 1: 240).

The focus in creating more access for engineering education is with no doubt important for this country and many people would agree on this. But this also has to produce engineers who have the capacity and ability to fulfill the needs of the country. If it becomes a threat to the quality of education, as pointed out by the teachers and students, it is likely that it needs some mechanism of improving in one way or another.

5.2.7.4. Shortage of Resources for Teaching and Learning

Almost all participants of the study mentioned that there is lack of recourses of different kinds including classrooms, laboratories and workshops. Almost all of them believed that the curriculum, as it is planned and implemented, could result better than what it is doing currently, had there been sufficient and relevant resources and everything is in place as per the requirements. None of the participant teachers and students has skipped mentioning the problems that prevail in the system and how such problems or shortage of resources affected the teaching and learning problems more than anything else. This was expressed by one of participant teachers as follows:

> *Teaching learning is poor, because of the different constraints in materials and resources in general. Materials are not sufficient compared to the number of the student population assigned in each group. The number of students in the lecture group is too many, 60 to 70 students per lecture*

class and 30 to 35 students per lab sessions, seats in the classroom are not comfortable. Students in both lecture and laboratories are very crowded, and hence, checking each student's work and progress is very difficult (N.2: p. 29).

The shortage of resources is not evident only in the physical resources such as that of shortage of laboratories. The unavailability of well qualified teachers, coupled with the absenteeism of the existing teachers from their teaching classes, can be regarded as the significant challenges within ASTU.

CHAPTER SIX

BAHIR DAR INSTITUTE OF TECHNOLOGY (BiT)

6.1. Introduction

This chapter deals with the third case, Bahir Dar Institute of Technology (BiT) as part of the overall case study of the curriculum development process of engineering education program in Ethiopia. Themes and the respective categories used in chapters Four and Five are used as the bases for the analysis and presentation of the empirical results, in the Chapter.

6.2. The Institute as a Context of Engineering Curriculum Implementation

This part is concerned with the location of the institute including programs and student population, experience prior engineering the curriculum reform, and the engineering curriculum reform within BiT.

6.2.1. Location, Programs and Student Population

BiT is situated in Bahir Dar city which is the capital city of the Amhara Regional State. The present BiT, in the past, provided technical education at different levels and has undergone through different status. It began as a technical school in 1963 (Fantahun, 2013) then developed to the level of college in 1968 and finally combined with the former Bahir Dar Teachers College to form Bahir Dar University in the year 2000. Currently BiT is one of the technology institutes which are part of the Bahir Dar University. Physically, BiT is situated outside the main campus of the university.

Bahir Dar city, into which BiT is found, is located approximately 553 kilometers away from Addis Ababa in the Northern direction. The city is recognized by UNESCO (2002) as one of the leading tourist destination in Ethiopia and was awarded the UNESCO Cities for Peace Prize in 2002 on the occasion held at Marrakesh.

Bahir Dar University is now regarded as being among the largest universities in the Federal Democratic Republic of Ethiopia (Bahirdar University, 2011: 9) with more than 35,000 students in its 57 undergraduate and 39 graduate programs. Bahir Dar University has four colleges, three institutes, three faculties and one school. The academic units of the University include College of Science, College of Agriculture and Environmental Sciences, College of Medical and Health Sciences, College of Business and Economics, Institute of Technology, Institute of Textile, Garment and Fashion Design, Institute of Land Administration, Blue Nile Water Institute, Faculty of Humanities, Faculty of Social Sciences, Faculty of Education and Behavioral Sciences and School of Law.

BiT, as an institute, is structured under four schools of: Chemical and Food Engineering, Civil and Water Resource Engineering, Computing and Electrical Engineering, and Mechanical and Industrial Engineering. As per the Academic Affairs Office of Bahir Dar Institute of Technology (2013), BiT caters a total of 9815 students, of whom 2375 are females.

6.2.2. Experience Prior Engineering Reform: Bahir Dar Faculty of Technology (BDU)

The present Bahir Dar Institute of Technology (BiT) has a history of its own that goes back to 1963 and that began as a Technical High School. It was established under the technical cooperation between the then Government of USSR and the Imperial Government of Ethiopia in 1963 (Fantahun, 2013). Because of the involvement of many Russians, especially at the initial stage, in its construction and training activities, it was sometimes called as the “Moscov School” by the local people.

At its beginning, that is in 1963, as a Technical School, it used to accept students who had successfully completed eighths grade and who were drawn from the different parts of the country. The fields of studies included in the curriculum, at that time were Agro-Mechanics, Electrical Technology, Industrial Chemistry, Textile Technology and Wood Technology. The time required to finish the training in these fields of studies was a total of four years. During this time almost all of the courses in the major areas were taught by Russians where as the general courses, such as those of Amharic, English, Mathematics, Physics, and History were taught by Ethiopians and Indians.

But within the subsequent year, in 1964 the school changed its admission requirements from that of the previous year and accepted students who successfully completed their tenth grade and who had high scores in subjects such as physics, English, Mathematics, and Chemistry. The school was also renamed as Polytechnic Institute (PTI) in the same year. In spite of raising the admission requirement, the time required for training remained to be the same four years as it was in the previous year, Moreover, in this changed provision of education students were made to choose their field of specialization after the successful completion of their first year studies. The remaining three years were devoted to intensive training in each of the specialized fields of study.

However, in the year 1968 the four-year program was again phased out and in its place a two year college level program was launched for students who had completed 12th grade. Admission requirements were also changed and based on the passing of the entrance examination that was provided by the institute to students who completed their secondary education and who passed the Ethiopian School Leaving Certificate (ESLCE). These were selected from all of the high schools within the country. However, the two programs, that is, the program which based its requirements on completion of grade ten and the program which based its admission requirement on the completion of grade 12 were run side by side until 1972. The first college level graduates received their diplomas in the year 1970. It was again upgraded to the level of a degree providing institute starting 1997 and continued in that status until it was merged with “Bahir Dar Pedagogical College” in 2000 to form Bahir Dar University. By the time the engineering education reform was begun, the present BiT was part of Baher Dar University with the status of School.

As a Technical School and as a Poly Technique Institute, it was administered by the MoE for more than one and half decade until it was finally handed over to the Commission for Higher Education (CHE) in 1979 and became part of the higher education system.

6.2.3. Engineering Curriculum Reform in BIT

The root for initiating engineering curriculum reform at BiT was not different from the other engineering institutions included in this study. It emanated from the ECBP engineering initiative. BiT, as it is now, did not exist then. It received the present status of an institute as one of the results of the overall engineering education reform. At the beginning of the reform it was one of the Faculties of Bahir Dar University designated as Faculty of Engineering. Neither the teachers of the faculty or the leaders in the institute were not the initiators of engineering curriculum reform. They have been informed by representatives from the MoE that engineering curriculum is necessary and that change was needed in this regard. As pointed out by the participants in this study they did not waste time to accept the idea and to involve in the reform activities.

6.3. The Engineering Curriculum Development Process

This part refers to policy initiatives, curriculum development process within BiT, and Teachers participation in curriculum development process.

6.3.1. Policy Initiative

Since the starting point for the recent reform of engineering education in Ethiopia, in general, was the ECBP, the curriculum reform deliberations in each of the three engineering education institutions (included in this study) trace back their reform history to ECBP. As it was pointed out in Chapters 4 and 5, of this study, the engineering curriculum development process was based on and guided by the framework provided by ECBP. The engineering education curriculum development process in BiT, like the other two engineering education institutions, was performed by curriculum reform committees established within the institution that made use of the advices of the senior staffs of Addis Ababa University.

6.3.2. The Curriculum Development Process within BIT

As pointed out herein above, the initiative that led the reform came from a source that was outside the institute. It was not from within, either by the teachers or by the leaders of the institute. The ECBP curriculum reform initiative was accepted enthusiastically by almost all of the engineering education staffs BiT (then BDU) from the beginning. The experience of providing engineering education was not new for the staffs in the faculty like it was in AAiT (Chapter 4). Or they nether have a long experience as in the case of ASTU (Chapter 6). The length of their experience in providing engineering education lies somewhere in between, that is, they started teaching engineering in the year 2000. They did not accept the initiative as a fresh ambitious group like it was in ASTU or with challenging arguments like it was in the case of AAiT. They accepted it without any hesitation.

Soon after they were informed the ideas of the reform by the representatives from MoE, as pointed out by one participant of this study, they reacted positively and started to do what they have to do as per the demands and ideas of the reform which was provided to them as pointed out by one of the participants of this study herein below:

> *That was really very acceptable by the staff and very much interested by the idea of what has been told by the representatives of the MoE for the first time. Every one of us was so fast to involve in the activities of change. Soon after, we did a survey of demand that included employers, teachers, workers, and students and we managed to produce a draft curriculum in relatively short time* (N. 24: p. 448).

Their positive response to the reform ideas might have emanated from two sources, as far as this researcher is concerned. The first of these might have come from the need of the staff to receive a special and particular attention as engineering educators and to improve their fields of studies in the way they would like it to be. Secondly, it might also be from their prior information and understanding of the direction of the engineering reform within the country. Whatsoever may be the case, they soon involved in surveying of the needs to start curriculum development by establishing committees peculiar to each of the fields of studies. They made use of the advice of one senior academic staff member from Addis Ababa University for each of the fields of studies (see, for example, Study programs of Mechanical Engineering (2007), Electrical and Computer Engineering (2007), and Civil Engineering (2007). As pointed out by the participants, their survey result indicated that the former graduates of the institute lacked practical skills and that graduates were not real problem solvers. On top of this primary information, they also made use of the already existing curriculum as one of base for reforming the curriculum. Through such process, they managed to produce a draft curriculum. And then the draft curriculum was made available for comments and suggestions of different stakeholders such as teachers and students including industry. Different workshops and meetings were used as a forum for collecting the feedbacks and the suggestions from different people at different levels within the faculty and at the level of the university.

6.3.3. Teachers Participation in Curriculum Development

As pointed out herein above, the initiative that led the reform came from a source that was outside the institute. It was not from within, either by the teachers or by the leaders of the institute. Therefore, before and during the actual process of curriculum development, teachers were invited by the ECBP to involve in a number of workshops and to learn the directions of the change and the actual substance that had to form the actual or the new engineering curriculum. Much of their involvement in the curriculum development process was guided by the directives they received from the ECBP as pointed out by one of the participants of this study herein below:

> *I have participated in the ECBP curriculum development workshops. They gave us training on what is meant by ECTS (European Credit Transfer System) and how to determine it. How much credit should a student take in each semester, how we can calculate the weight of each course and to determine the ECTS for each of the courses* (N.23: p. 436).

From what has been said herein above, one can see and understand that the teachers in AiT had to learn what was proposed by the ECBP and accommodate it within their curriculum. Even though they have performed a survey of the needs at the local level, and managed to identify the shortcomings prevailing within the previous curriculum, the core orientation that guided the whole curriculum was the one which was suggested by the ECBP. The teacher's role in this case was limited to that of accepting the suggestions and work in line with it rather than deciding by themselves on what the curriculum should contain and how it should be framed.

6.4. The Content of Engineering Curriculum

Engineering curriculum, like any curriculum used at any level of teaching learning is an indicative of what teachers as teachers and students as students do in the teaching learning process. It informs both teachers and students on what to concentrate and what to do in that endeavor of teaching and learning. Included in this part of the study are the expectations pointed out within the curriculum seen against what is practiced at the institution level.

6.4.1. Curriculum Expectations

As it has been pointed out in Chapter 5 the way teachers perceive curriculum entails a difference on the type of content they select to teach their students and the methods they use in their teaching of engineering subjects. In analyzing the curricula documents in BiT, the content of engineering education is organized to provide "broad based education" (BDU, Mech. Eng., 2007: 3), "to give more emphasis to practical aspect of engineering" (BDU, Elec. Eng. 2007: 4) to offer a B. Sc. Program covering all important branches and disciplines" (BDU, Civil Eng., 2007: 4).

Though the expectations of the different curricula, as has been seen here, are expressed in different ways, an in-depth examination of their contents shows: that they all are structured in modular forms, that they all included internship practice as mandatory, that they all require five years of study, and have more of similar features with regard to their structures than differences.

Statement in all of the curricula documents express that students at the end of their education have to have knowledge and skill that satisfies the need of industry, have entrepreneurial and managerial skills, and they all need their students to apply knowledge of mathematics, science and engineering, design and conduct experiments, as well as ability to analyze and interpret data, function on multi-disciplinary teams, identify, formulate, analyze, and solve engineering problems, including ability to communicate effectively and understanding of professional and ethical responsibility in the students. The following structure of Mechanical Engineering curriculum is an example of how the curricula were structured.

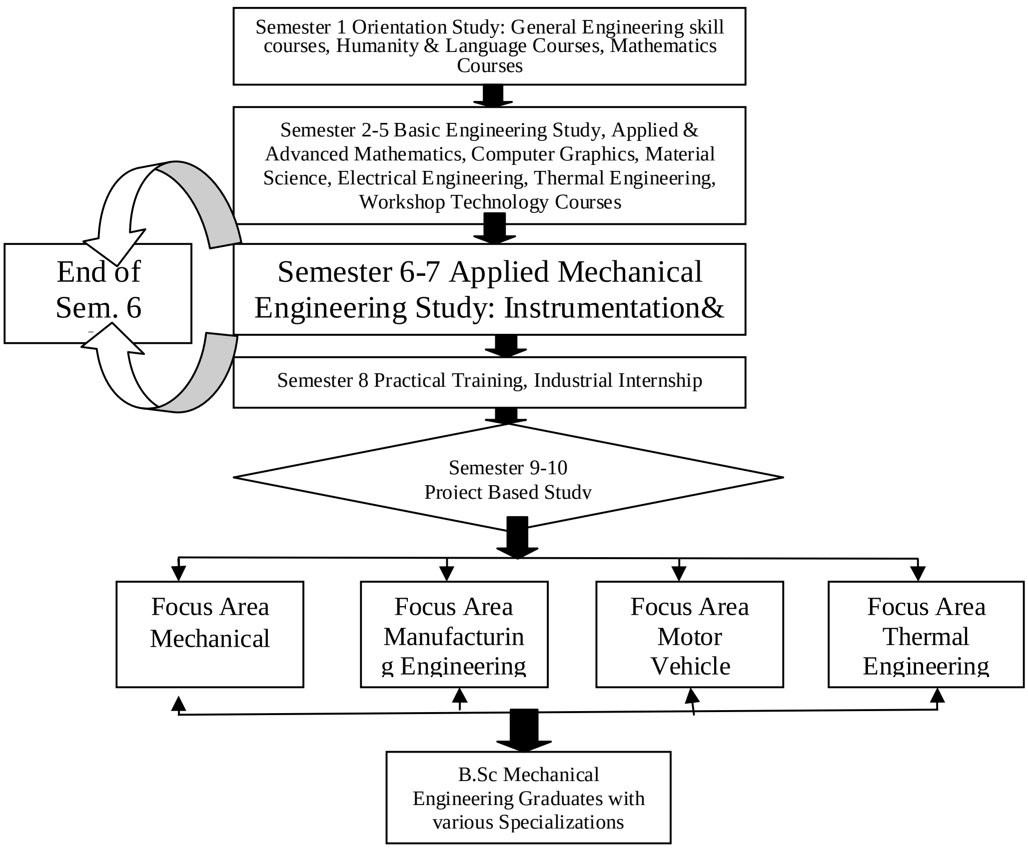


Figure 7 Diagram expressing the structure of Mechanical Engineering

Source: Department of Mechanical Engineering, Bahirdar University (2007, p. 15)

Courses that are used to realize such expectations are arranged in modules such as that of General Engineering Skill Module, Basic Science Modules such as Applied Mathematics and Advanced Mathematics Modules, Humanities and Language Module, Communication and Entrepreneurship Module, Core Engineering Sciences Modules such as Machine Drawing and Computer Graphics, Engineering Mechanics, Mechanics of Materials, Advanced Engineering Mechanics Supportive Engineering Sciences Modules such as Material Science and Electrical Engineering Modules can be cited as examples. More specifically, the curricula documents suggest that content of engineering education is defined in relation to the competencies identified to enable engineering students to understand and be able to do the things they have to do. This means that the content of engineering education has to focus mainly and be structured around knowledge and skill bases that would enable the students to apply them to a pre-specified ends. This, in the context of this study, means the knowledge and skill that is learned by the students has to be able to create their graduate profile as specified by the curriculum; not as they would like it to be.

This, however, does not mean that all the content specified in the curriculum does not contribute to what the students would like to be. The mathematical and engineering sciences provided to engineers come from the same root wherever the country may be. What varies most is the degree of concentration and the way it is provided, that is, the availability of materials, the qualification of teachers, the technology used for teaching, and the commitment of the leadership in introducing and enforcing quality boosting ideas.

6.5. Perceptions of the Field of Engineering Education and Curriculum

As has been indicated in the case of ASTU, in Chapter Five, different teachers and or students perceive engineering education and engineering curriculum in different ways. The major concern, in all cases, however, is the production of the best engineers that can provide the best services of engineering. Their differences mainly emanate from the degree of the emphasis they put on the theoretical aspect or on the practical skills of engineering. For some of the teachers engineering education at the undergraduate level should focus more on the engineering sciences and related mathematics and analytical skills in these areas. For some others, the most important thing in engineering education is the acquisition of engineering skills associated with the solving of practical problems together with relatively enough knowledge of engineering sciences and related mathematics. Teachers in BiT are not different in this regard. For instance, one of the participants in this study describes engineering education as follows:

> *Engineering education is a field of study which focuses on solving of problems and it is a field that enables individuals to create new things that would help the society. It is always related to solving engineering problems, which are prevailing within the society, and it strives for the betterment of human life* (N.26: p 407).

What we see in this quotation is the emphasis on solving of problems which implies an inclination towards the practical. Nevertheless, higher emphasis on the theoretical alone is not favored by any of the teachers. This can be understood from what one participant of this study says in the following:

> *The strength of the reformed curriculum is its emphasis on laboratory. But the fact that it gives a chance for students to pass their examination without much knowledge of the theoretical aspect, because even if a student gets 0 in the theoretical examinations, he/she can score a passing mark by doing the practical aspects only* (N. 23: p. 442).

6.6. Teaching and Learning: The interface Between Engineering Education Curriculum and Engineering Education Practice.

Included in this part are engineering teaching in BiT, and the assessment mechanism together with a brief description of the overall challenges.

6.6.1. Engineering Teaching in BIT

As pointed out in the curricular documents of BiT methods in the teaching of engineering include: classroom lectures backed by course-work projects, tutorials and assignments; workshop practice and laboratory experiments and design assignments, presentations; industrial visits, demonstrations, simulation and industry internship (BDU, Mech. Eng, 2007: 27; BDU, Civil Eng. 2007: 15; BDU, Electrical eng. 2007: 13).

Research findings in the different methods of teaching and learning in other situations indicate that the successful application of individual or mixed methods of teaching such as those indicated in BiT curricular documents depends on the existence of other variables such as those of the conditions of classrooms, laboratories, and workshops, teacher preparedness and skill, availability of materials, student motivation, and others.

As we all know the teacher's role within the teaching learning process includes the preparation and delivery of new ideas and materials that can assist student's learning. On the other hand students are the ones who are expected to gain knowledge and skill from such material and communication. The successful implementation of any curriculum then presupposes the availability of the various variables pointed out herein above and the synchrony between these elements to result in what is called quality teaching and learning. Quality teaching in higher education matters for student learning outcomes. But fostering quality teaching can be threatened when the bondage between those variables is loosely structured and incompatibility exists.

It has been indicated time and again in this study that the way teachers perceive curriculum and content affects their teaching of engineering education and ultimately the students' learning in terms of what they know and be able to. The teaching learning process in engineering education at BiT, like in the engineering education institutions which are dealt with in this study, refers to the teaching learning of different courses arranged in modules. Different modules such as that of the humanities and social sciences, Business, and others, in addition to the major and related engineering discipline form the content of engineering education in BiT.

Most of the core modules in engineering teaching and learning require the use of laboratories and well equipped workshops and materials in addition to classrooms. The availability or unavailability of such things in sufficient quantity to the number of students facilitates or hampers students' in many ways. As pointed out by teacher participants of this study:

> *Active teaching-learning is not practiced well. The first thing we don't have books, shortage of instructors & the existing ones are overloaded. We don't have laboratories even classrooms. In*

> *our school we have 2000 students. To give feedback of assignments is not possible with much student number. To make the* class in the mode of active teaching-learning is unthinkable these days (N.23: p. 443).

6.6.2. Student Assessment and Evaluation

Curricular documents in BiT indicate that any student to be assessed has to fulfill the attendance requirements as stated in the following:

At the end of each semester, the student sits for final examinations of the courses he/she has attended (minimum 75% for lectures and tutorials, 100% for practical exercises). A student must pass the examinations for all the courses in addition to the Holistic Examination at the end of the sixth semester (BDU, Elec. Eng. 2007: 13).

In BiT there is no evidence of providing what is called "holistic" examination. As can be seen here, a student to be legible for examination he/she has to attend lectures for about three quarters of the time set for it and full time participation for practical exercises. Irrespective of attending classes and performing the tasks set for practical exercises the actual student assessment at BiT involves written and mid, final examination including assignments for the theoretical part of learning and assignments, quizzes, project (in some cases) for work that includes laboratory experiments and workshop practices.

One important point worth to note here is that assessment in BiT is more focused in what is called activities such as tutorial, group and individual assignments and the like. Such activities and tutorials, as indicated by one participant of this study, involve at least three assignments, and about five quizzes which has high value in determining the students' scoring of grades and passing the exam in the end. This means, if a student scores high marks in practical activities and scores a very least mark in the mid and final examinations, it is likely that the student would obtain not only a passing grade but also better than that.

Though this is the working condition of assessment, both teachers and students recognize that there is somehow a problem in this kind of assessment mechanism. For instance, one of the participant teachers in this study indicates the weakness of giving emphasis to assignments and laboratory work as follows:

> It (referring to assignments and laboratory work) gives a chance to students to pass their examination without having the knowledge of the theoretical aspect, because even if he/she scores 0 in the theoretical examination, they can pass with the results of the practical. It misbalances the theory with practical (N. 23: p.442).

This is also observed by the focus group discussion participant students in a more or less similar way to that of teachers. An example of this is as follows:

> Assessment is performed on day-to-day bases. Since 60% of the score has to come from assignments and some lab activities more concentration is given to it. You learn to satisfy that rather than being concerned about the theoretical knowledge and the principles underlying those practices (FG3: p. 456).

From the responses of the participants in this study one can understand that the assessment mechanism do not seem to satisfy both teachers and students. Nevertheless, neither the teachers nor the students have the power to put it in another way other than accepting it and performing it as it is suggested in the curriculum document and in other curricular guides. However, had there been a real commitment for the teaching profession and had there not been dissatisfaction with rewards they are receiving from their services of teaching, compared to what the market pays to engineers at their level, probably teachers could have done something better than they are doing now.

Suggestions of curricula with regard to assessment such as those of employing a holistic examination, just in the same way as that of discussed in the two preceding chapters, remain unresolved or unemployed in the sense it is suggested.

Curriculum evaluation, like it has been mentioned in the chapters that proceed, is not a common word, at least in the engineering curricula documents used for this study, in the sense it is found in many curriculum text books. Common in the documents is the term "quality assurance" (BDU, Mech. Eng. 2007: 29; BDU, Elec. Eng. 2007: 14) which is directly connected with the quality of the program.

6.7. Challenges of Engineering Curriculum Implementation at BIT

BiT, like the other cases described in this study, faces a number of challenges like that of lack of qualified teachers, shortage of materials (in some cases shortage of machineries), shortage of laboratory equipments and laboratories including insufficiency of classrooms unavailability of books within the libraries, and others are among the pressing needs. As pointed out by the participant teachers and students, problems related to resources are more problematic for the teaching learning process of engineering in BiT than it is with the curriculum with the problem of curriculum. In fact the idea of "modularization" is also regarded as one of the challenges by some teachers.

6.7.1. Teacher Quantity and Quality

As pointed out by the teachers as well as students of BiT, unavailability of teachers in sufficient number and quality is one of the most pressing problems in BiT. This situation coupled with other teaching learning resource shortages are thought to be hindrances for practicing active teaching and learning methods. The shortage in the number of teachers, in one way or another, is associated with the large number of students. The following statement which was said by one of the deans at BiT is expressive of this situation.

> *Active learning is not practiced well. In the first thing we don't have enough books in the libraries. There is shortage of instructors and the existing ones are overloaded. We don't have laboratories, even in some cases classrooms. In our school we have 2000 student. To give feedback of assignments is not possible with big number of students. To make the class in the mode of active learning is unthinkable these days* (N.23: p. 443).

The problem connected to the way how they approach their teaching profession is also expressed as the following by students.

> What constrains us this time is what is called "student-centered teaching and learning". For instance, the teacher comes with his LCD(referring to the electronic projecting tool), reads it in the class and he/she goes out. Suppose we don't understand it and ask him/her some questions, he/she says 'my duty is to give you some hints; the rest is yours (FG3, p. 459).

From these two expressions one can understand how serious the problem is. On one hand there is shortage in the number of teachers. Even if there are teachers, they are not teaching to the level expected by students. On the other hand, in some cases, the idea of "student-centered teaching learning" is used as an excuse for teachers' inappropriate approach of their work.

Students also describe teachers as they are lacking practical experiences that would enable them to teach portions of lessons that include practical activity. One statement that is expressive of this idea is indicated herein below:

> Teachers do not have practical experience. They are not practically competent; because they did not work practical thing outside. They read manuals and try to teach us from that. In most cases courses of practical nature are being turned to theory. Teachers have to go out and see what is there in the factories. This lack of practical experience is also the same with the lab assistants. They don't know much, but they are assigned to teach us in the lab sessions (FG3: p. 467).

6.7.2. Student Population

Teachers as well as students of BiT consider the existence of large number of students within each session of classes and or laboratories, as a challenge for implementing the curriculum. According to such participants, the intention or the standards set for the number of students in a class and laboratories was different from what is practiced now on the ground. For instance, one of the participants of the study stipulates his ideas in relation to what he called "an orientation course" (Introduction to Engineering Skill (GEng-1001)), which was intended to "enable students understand the constructive interrelation of natural & social sciences as well as business and art to engineering and their positive impact on the socioeconomic aspect of a society" (Department of Electrical Engineering 2007: 33), as follows:

> It was intended to provide some skill practices with this course assuming that the number of students within a class would be as set by the curriculum, which is, 50 students per class. But the reality on the ground shows that the number of the students in a class is well above that. Hence, the teaching of the course did not go well as it was originally intended (N.23: p. 441).

According to this participant, the intention with this course was to practically orient students with the different fields of engineering by taking and teaching them within the different laboratories established for the practices of the different engineering fields of studies. But as a result of the large number of students was not possible to teach the course as it was intended.

6.7.3. Shortage of Resources

Teachers as well as students in BiT indicate that there is shortage of teaching-learning resources which can be expressed in terms of material and human resources. While shortage of classrooms and laboratories, shortage of laboratory machineries and equipments fall into shortage of physical resources, lack of qualified and committed teachers that would tech as per the requirements of the curriculum fall into shortage of human resources. With regard to shortages material teachers indicate that there is shortage of different resources. As a result, employing active teaching and learning methods in a classroom situation and in laboratory sessions became too difficult.

> *Active teaching and learning is not practiced well. In the first place we don't have enough books for the students. There is also shortage of instructors and the existing ones are overloaded. We also don't have laboratories, even classrooms* (N. 23: p. 443)

This expression of the participant teacher was also shared by the students who were involved on the focus group discussion.

> …on the other hand, when we go to the library, there is no book. In some departments there are only three for 180 students (e.g. Electrical Engineering). In the relatively better departments handouts are provided (e.g. Civil Engineering) (FG3: 460).

This clearly shows the limitations of BIT in terms of both material and human resources and the prevailing of such a case has become the source of worry for both teachers and students.

CHAPTER SEVEN

CROSS-CASE ANALYSIS AND DISCUSSION

7.1. Introduction

In the preceding chapters of this study this researcher has presented the policies, perspectives and issues that shaped engineering curriculum development in Ethiopia and its implementation within three selected higher education engineering and technology institutions. The main concerns of policy, policy guides, and issues that contributed to and shaped the education reform in Ethiopia in general and those related to higher education in particular, including the reform in engineering education, are presented in Chapter One of this study. Chapter Two dealt with the review of related literature focusing on the concepts, nature of curriculum and curriculum development of higher education and engineering education. This chapter also included a brief description of the development of education in Ethiopia as a milieu for engineering curriculum development process. Finally, Chapters Four, Five, and Six, focused separately on three case studies into which the reformed engineering education curriculum is implemented and experienced by engineering teachers and students. The chapters dealt with the presentation of the results of the empirical data collected from the teachers, students, and other stakeholders.

What is presented in this chapter is a cross-case analysis which draws on evidence from the literature, the context of education in Ethiopia and from each of the case studies presented in Chapters Four, Five and Six. The cross-case analysis in the chapter is then organized around the five broad themes emerged from the analysis of the data presented in the preceding chapters.

7.2. The Institute as a Context of Engineering Curriculum Implementation

Analysis under this theme involved geographic location, experiences of the institutions prior to the engineering curriculum reform, and the idea of engineering curriculum reform within the three engineering education institutions. The findings revealed that the three institutions had different experiences with regard to the provision of engineering education prior the engineering curriculum reform. While AAiT and BiT have prior experiences in providing engineering education prior to the engineering curriculum reform, ASTU, on the other hand, was just a beginner during the start of the engineering curriculum reform. ASTU as an institution has experienced frequent curriculum changes that concerned both teachers and students more than it concerned the teachers and students of the other two cases in this study. Curriculum research in general shows and suggests that collectively shared guiding vision provides a strong foundation for comprehensive curriculum review process (Oliver and Hyun, 2011) which is lacking in this case. Morgan and Houghton (2011) think that "inclusive curriculum design benefits both staff and students when it is based on principles of equity, collaboration, flexibility and accountability" (Morgan and Houghton 2011: 5). The analysis, however, has shown that the initiative for the reform did not emanate from any of the institutions under this study. The reform initiative was totally alien to all of the institutions and belonged to the ECBP, which was functioning under the leadership of MoCB at the beginning. Curriculum change has to influence institutional practices in terms of its "depth" and its "pervasiveness" (Lattuca & Stark 2009). This was discussed in more depth in chapter two of this study (see pp. 35-38).

However, the role played by each of the institutions varied significantly once the initiative was introduced to the institutions. The teaching staff in AAiT (as part of the former Faculty of Technology) took the lead in participating in the engineering curriculum reform activities right from the beginning of the initiative due to their long year of experiences in providing engineering education and due to their better qualification, capacity, and ability. Hence, the curriculum reform activities of each of the institutions have taken different departure. While AAiT's curriculum development process was performed with close support and advice of the German professors employed by the ECBP, more of the activities of curriculum reform in other institutions were developed based on the curriculum structure of the AAiT. In most of these cases the staff in AAiT served as external advisors during the curriculum development process. Basically, all public and regional universities "depend considerably on graduates of the AAU" **(**Cordier, 2007: 36), (also see the curricula documents of BiT: Study Program for the Degree of Bachelor of Science (B.Sc.) in Mechanical Engineering (2007: 1), Study Program for the Degree of Bachelor of Science (B.Sc.) in Electrical and Computer Engineering (2007: 1) and, Study Program for the Degree of Bachelor of Science (B.Sc.) in Civil Engineering (2007: 2). However, both of the institutions, in their part, have conducted needs assessment to adjust to the ECBP curriculum framework and to come up with a curriculum they thought to be appropriate to students and relevant to the knowledge and skill requirements in the industry.

7.3. Perceptions of the Field of Engineering Education and Engineering Curriculum

The findings of this study revealed that engineering teachers perceived engineering education and/or engineering curriculum in different ways. None of these perceptions, however, are not different from what is known and what is perceived about engineering profession, engineering education, and/or engineering curriculum in general (see for example (Karseth 2006). Perceptions of the engineering profession, engineering education, and/or engineering curriculum usually differ on the emphasis one places on the different aspects of the engineering profession. As revealed in this study some of the perceptions emphasized more on the acquisition of knowledge in engineering sciences and the related mathematics and curriculum as a means for reflecting this reality for students' learning. Others considered engineering education as means for solving practical problems based on the theoretical principles and the curriculum has to reflect both the theoretical and practical aspects for students' learning.

Engineering profession by its nature calls for the use of different theoretical bases from different disciplines and it involves practice that translates these theoretical bases of the different disciplines into something useful and tangible output. So the reasons for the differences in perceptions of the teachers emanate from ones emphasis on either the theoretical bases of engineering or on the practical aspects (example, Felder, (2012), Dym, et al. (2005); Crawley, et al. (2008). According to Felder (2012) the difference emanate from "two approaches to knowledge, learning, and teaching" (Felder 2012: 2). These approaches, as pointed out by Felder (2012) are the traditional paradigm, which has dominated engineering education since its inception, and the emerging alternative that offers predictions about the eventual resolution. On the other hand, an examination of the curricular documents of all institutions and the education policy and guides of the government reveal the advocacy to be more for (though not out rightly reject the need for theory) practice oriented education (Bahirdar University, 2007; ASTU, 2011). As a result, many of the modules that form engineering education within the institutions reflect in the curricula both theory and practice with a separate time allocated to each of them.

However, as it is revealed in this study, the implementation of engineering education within the institutions is dominated with more of theoretical than that of the practical aspect. In some respects courses that are practical in their nature are turned to theoretical provision. This implies that there is a problem in attaining the objectives of engineering education and that the changes which are needed to be brought and curriculum implementation are moving in a diverging direction.

7.4. Hopes and Promises Embedded in Reforming Engineering Curriculum

The orientation and perspectives and the basic tenets of curriculum development which are enshrined in the different policy and other related documents of the government (e.g. MoE, 2004; MoE, 2003; MoE 2009), together with the findings of the study in the three sites show, the reform in engineering education was more of economic and social development in their nature in the Ethiopian context, It was economic because, the goal of engineering education as emphasized by many of the government documents (FDRE, Proclamation No. 256/2001; Knoop, n.d) were targeted to the production and development of skilled human resource that would work in the industry. Since the field of engineering is regarded as a crucial part in the economic development of the country, a significant number of young people who are accepted to enroll to higher education are directed to join the various fields of engineering education (MoE, 2008). This obviously implies that more of the resources allocated for higher education are reserved for engineering education with the assumption of producing engineers capable of doing the work the industry needs and who can create a milieu for technology transfer.

The other orientation that guided the reform in higher education is social in its nature, which is expressed in terms of equity. This is expressed in two inseparable ways. The first of these is the concern of creating more opportunity for an extended provision of higher education, which includes engineering education, to a large number of individuals, who were in the past deprived of it (see, for example, ESDP IV: p. 64). This, on the one hand, has attracted many adult members of the society who are involved and working in different public and private sectors. On the other hand, the policy that opened the gate wider for engineering education attracted more young students who could otherwise work better and benefit more if they could join the other fields of science such as management and accounting. As a result, higher education institutions started to create courses and methods of delivery that suits people in such position, usually at the expense of quality in education. The second aspect of equity arises from the need of government to avail educational institutions in close vicinity to the wider populace residing in the wider spatial area of the country. One of the evidences for this is the opening of new universities within a short span of time. However, these institutions operate under poor provision of lack of qualified and experienced teachers, lack of laboratories and workshops to work in and entangled with a number of related problems such as that of the unavailability of resources for students to work with and to learn the necessary knowledge or acquire the skills.

In addition to the economic and social orientations, there is also another element that had a significant role in shaping the reform of higher education in Ethiopia. This arises from the need of meeting the international expectations (Bayou et al 2006: 15) of higher education in general and trying to meet the standards in accordance with it. This has resulted in the introduction of new elements such as modular arrangement of courses, student-centered teaching and learning, continuous assessment, new credit transfer systems (ECTS) and others, on top of the previously known ways of providing higher education, especially in engineering education. Though aligning the higher education system with the international practices is unavoidable, the immature condition, in terms of availing the appropriate human and material resources for its proper application has left teachers and students in a state of confusion. All in all, it implies that the implementation of the reformed curriculum was started with premature conditions which can be expressed in terms of: (1) lack of availing the necessary laboratories, workshops including the equipments and materials within them; (2) shortage of well qualified and well informed teaching staff; (3) lack of follow-up in implementing the change.

7.5. Active Teaching and Learning Methods: Approached to the Goal but Failed to hit the Target

An examination of policy documents as well as the reformed curricular materials of engineering education point out that one of the most important things needed in engineering education is the acquisition and the development of knowledge in engineering sciences and design, together with the related knowledge of other sciences and mathematics including some modules from the humanities field of study. The documents, in addition, highlight the necessity in the acquisition of skills of various kinds such as those of skills in critical thinking, communication, and in doing experiments and laboratory work, and others.

The idea of employing different teaching-learning methods in the teaching learning situation in general is the idea accepted by many educators long ago. Research also shows that students learn better when they are exposed to different teaching and learning methods (Felder & Henriques, 1995; Knowles, 1973). The findings of this study also reveal that teacher and student participants in this study do not deny that there are some attempts of employing different practices in their teaching and learning situation. However, they all express that they are not satisfied with what the teachers are doing as teachers and with what the students are doing as students.

As it has been pointed out in Chapter Two of this study, learning theories, such as that of constructivism and Andragogy, inform us that students learn more and better when they are in a position to participate and construct their own learning. The essence in this assumption is that students learn better when they are provided with the appropriate condition for their learning. Appropriate condition for engineering education obviously, involves among other things, the availability of classroom situations that allow students to communicate with their teachers and peers, availability of books and other reading materials to learn and acquire the knowledge of engineering and other sciences, availability of workshops and laboratories that are sufficient for students to practice in and perform the necessary experiments, experienced, knowledgeable, and motivated teachers who facilitate students' learning with appropriate guide and feedback, machinery, equipment and other accompanying resources to practice and learn the engineering practices. With less or no provision of these resources, it would be difficult to attain the goal of engineering education.

Modern learning theories and Andragogy also inform us that students need varying approaches of teaching and learning rather than sticking to one or two approaches. Lecture methods, demonstrations, discussion methods, assignments, problem based learning, project based learning, laboratory experiments, workshop practices, internships, are some of the among many teaching learning methods that are advocated in the policy document and in the reformed curricular documents of engineering education and which are needed to be employed in the teaching learning of engineering education.

The Ethiopian education policy documents and curricular materials (MoE, 1994; MoE, 2003; MoE; 2009; ESDP IV, 2010;) also advocate that students will be provided with the necessary conditions for their learning. But the findings of this study reveal that neither the conditions of the study are not fulfilled nor the methods of teaching and learning are applied as per the suggestions provided in the documents. The findings further reveal that the dominant method of teaching and learning, apart from labs, is still more of lecture method, with a large number of students in a class and in a difficult situation. Application of demonstration and discussion methods to the required level, are difficult partly due to the large number of students in every session and partly due to the in- sufficiency of equipments and materials. Assignments, as a method of teaching and learning, is threatened with students' improper handling and misusing it and due to lack of proper follow-up from the side of the teachers.

A serious problem in this regard is the teachers' lack of providing feedback to students. Problem based, project based learning, experiments, workshop practices, though practiced in a limited way, in most cases they are hampered partly due to the large number of students and to a larger extent due to the shortage of facilities such as that of laboratory equipments and accompanying resources. Teachers, sometimes, try to practice such methods with the limited available materials and equipments but they fail to provide feedback, for example, for students' assignments and projects.

Internship as a method of teaching and learning in engineering education is one of the embraced method by education policy makers, teachers, industry personnel, and students who participated in this study. Policy documents and curricular materials advocate the importance of internship for students' learning. All curricula documents have incorporated in the engineering education program a one semester internship training for the students. Institutions have also assigned some teachers who have to organize and follow-up the proper functioning of the internship program.

However, implementation of internship training is not without problems of its own. Limited number of industries as compared to the number of students who need internship, leaves students in a situation of wasting too much of their time in searching one, especially in their close vicinity. When they find one in the close vicinity of their institution, it is relatively better because they can meet their supervisor from the university at least once in a while. But if they do not find one in close vicinity it will remain as an internship without follow up and this was the fact experienced by the students who were assigned for their internship training far away from their institutions in the past.

Another problem with internship training is lack of a clear academic guideline with what the students do within the industry. As the finding of this study indicated neither the students nor teachers know what exactly a student would do within the industry training. For instance, a student of Electrical Engineering would go to an industry where electrical engineering is practiced with a broad idea of Electrical Engineering rather than with a specific area within that broad field of study. This has created a difficult situation for both students and for those who are responsible for internship training from the side of the industry. Industry applies activities of Electrical Engineering in different situations. For industry there is no chance to bring all applications of Electrical Engineering in one place and to train all students in the same way. Different applications of Electrical Engineering are practiced in different ways and sometimes in different sites. Hence, as the finding of this study revealed, industry needs students to be clear of their focus and to come to it with specific identified needs for their internship training. If this happens, it will be easier for those who are responsible within the industry to give specific opportunity of training where students can gain the maximum benefit in their focus area.

In general, it implies that internship as a means of teaching and learning is not well exploited due to the reasons which are attributed to: (1) lack of the necessary management and coordination from the side of the institutions; (2) lack of planning and follow-up from the side of teachers; and (3) lack of a clear understanding of the purpose of internship from the side of students.

7.6. Student Assessment as a Ladder to Climb up

As pointed out in the education policy documents and the curricular materials, the purpose of student assessment is to find out the degree to which students have understood the subjects they have learned and to find out where help is required. Assessment, in general refers to collecting data about the quality of student learning (Olds, et al 2005). If a student's assessment result is found to be low, in terms of knowing and understanding of the subject he/she is supposed to know, this implies or suggests that support from the teacher is required in order to improve the students' learning. It also gives a clue to the teacher whether or not to diversify his method of teaching in favor of the improvement of students' learning within the whole class. Assessment can also be used to gauge students' relative stand among the students in a group or in many groups of students. Approaches to assessment can take many types or forms such as assignments, quizzes, mid and final examination, project work and others.

An examination of the available documents and policy guides including engineering curricula documents reveal that the most favored assessment approach is what is known as continuous assessment. This approach suggests that students have to be assessed continuously in different ways rather than judging their ability and understanding of the subject they learn with one or two examination/s. The process of continuous assessment requires teachers to provide feedback to students for every assessment they give to students. Though it is part of the mechanism by which the students passing or failure is determined, its main purpose, as stipulated in the documents, is improving students' learning by way of providing feedback to students or by way of changing the teaching method or methods in such a way that it suits students' learning.

As revealed in the findings of this study, continuous assessment seemed to have failed to do what it is purported to do and in some cases it has become an easy way of students' survival within the institutions. Group and individual assignments as a genuine means of assessment seem to have lost the credibility by many of the students. While few of the students genuinely benefit from assignments in terms of learning the subjects and in terms of scoring higher scores, many others end up copying from those who have worked by themselves and obtain marks. Though teachers are aware of the existence of such a situation among the student body, they admit that they do not have time to check how each student produces his/her assignment work, and they attribute this to the large number of students they are handling and the shortage of time they have.

Quizzes are also regarded as a means of continuous assessment. But as it is revealed in the findings of this study, especially in the case of BiT, quizzes are good for obtaining passing marks because students are told well ahead of time to make themselves ready for the quiz in the particular topic or topics they have covered. They learn the topics or chapters in a fragmented way without giving due concern to its connection to the whole of the main course. But the problem with it, according to the participant students, is its effect in continuously detaching them from the essence of the main course for which they are registered. By the time they learn a specific topic for the purpose of passing each quiz and repeat this several times they tend to lose the connections between the portions covered by the quiz and the broader course for which the topic or the topics are learned. Even though they do not pass in the final examination of that particular course, the cumulative scours of assignments and quizzes would give to the students the opportunity to get a passing mark in the course they have registered for, which means passing the course without the grasping the kernel of the course. This implies the need for better coordination of assignments, projects, and quizzes as a means of assessment.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

8.1. Introduction

The intention in this chapter is to summarize the answers to each of the four research questions posed in Chapter One of the present study in association with the key findings obtained from the analysis. Hence, the chapter, in general, is organized under the four research questions, together with the conclusions drawn from these findings. Finally, a number of recommendations which are thought to be pertinent are forwarded.

8.2. Why was the engineering curriculum reform initiated? How was it developed?

As the findings of this study show, the idea of reform in engineering education was not generated either by the teachers of the engineering institutions or by the leaders of those engineering institutions. It was initiated by ECBP under the leadership of the Ministry of Capacity Building (MoCB). The intention of the university reform component of the ECBP was more of economic interest to support the transformation of higher education to be able to generate the most needed human capital for the work in the labor market of the industry. On the other hand, it was an idea whose target was to support the industry by producing skilled work force that is equipped with knowledge, and ability within the higher education institutions. Although Addis Ababa University was given the opportunity, as it is revealed in the findings of this study, to take the lead and undertake the reform by itself, it did not opt to undertake the reform by itself, but allowed the Faculty of Technology to join the ECBP to perform the reform task together with members in ECBP. The Faculty of Technology was the more preferred engineering institution by the ECBP because of its long experience in providing engineering education and because of the availability of more experienced, knowledgeable and highly qualified teachers within it than in the other engineering institutions existing by then.

Members of the Faculty of Technology at AAiT, under the support of the ECBP and in collaboration with the advice and support of the German professors managed to establish different committees that would deliver on the curriculum development. Each of the committees representing the different engineering fields of studies, after a long time of exercises, meetings, and workshops managed to produce the first generation of curricula in the year 2007 which also served as a spring board for the curriculum development process in the other higher education institutions. These were taken to Germany for a peer review of an accrediting agency known as ACQIN. This process resulted in preaccreditation of the curricula but not the program of engineering education as a whole. However, with this at hand the curricula were implemented in the form of "pilot" implementation in the year 2006/2007 academic year. This then marked the starting point for the implementation of the reformed engineering curricula at least in AAiT.

Engineering curricula for other similar institutions were also produced following the lead of the Faculty of Technology by adopting the curricula which was produced by the Faculty of Technology together with ECBP. In this later case some members of the Faculty of Technology served as advisors to the other institutions, in place of the German advisors. For instance, during the engineering curricula development process of BiT (then Engineering Faculty at Bahirdar University) different staff of AAiT, who are specializing in different fields of study, had served as external advisors.

From these findings, it can be concluded:

The idea of initiating engineering education reform and curricula was an idea that was totally brought by the ECBP. Of course, members of the Faculty of Technology of Addis Ababa University were also active participants in the development of curricula, but under the support of ECBP and under the guidance of the advisors from Germany. The teachers' participation in these activities was not one of independent decision making about the different elements of curricula, but one of learning the decisions of the ECBP and trying to put it in the curricula. The approach in general can be labeled as a top-down approach since the very decisions were determined at the top level. This implies the need for raising and ensuring the awareness of teachers about the ideas of the change in engineering education, understanding of the new decisions together with the newly included curriculum concepts and their purposes.

The target, in reforming engineering education was to produce educated and skilled human resource for the labor market. As the findings of this study reveal, the teaching learning process is affected negatively by teacher absenteeism, shortage of laboratory and workshop equipments, inappropriate assessment mechanism and students' trifling learning styles. This implies that there is a long way to go to improve engineering curriculum development and its implementation within the specific engineering education institutions in Ethiopia. It also implies the need for having teachers who bear responsibility for their teaching, who are highly committed to translate the curriculum and implement it to result in students' learning. In addition, it implies the need for improving and upgrading the teachers' knowledge, understanding, and skills in different methods of teaching and learning that assist students' learning. It also implies the need for adopting new ways of student assessment mechanism than the traditional pencil and paper methods which is still dominant within the institutions.

8.3. How do deans, teachers and students view and describe engineering curriculum and the congruency between the curriculum expectations and its implementation?

As the findings of the study reveal, different teachers see the curriculum in different ways. For some of the teachers engineering curriculum is seen as a plan that leads students to an in-depth learning of engineering sciences and other related subjects. This tends to imply the need for more theoretical knowledge of engineering and the curriculum has to reflect this reality. It also implies that teachers have to give more focus to the theoretical knowledge when they teach students, which is actually in contrary to the ideas of the reformed curriculum. Others associate the objective of engineering education with the developmental agenda of the country; engineering curricula in such case then have to be oriented more to practice than theory. This obviously implies the need for problem solving which is consistent with the reformed curricula. It also suggests that teaching and learning have to look into a problem and try to solve it. Nevertheless, both of these perspectives do not exist separately in the real world. Engineering education without the theoretical backgrounds of the sciences, mathematics and other related sciences cannot exist in this modern era of engineering. In other words engineering education devoid of practical experiences and skills associated with it is no more important than not having it.

As far as the findings of this study show teachers, deans as well as students do believe that implementation of engineering curriculum is seriously jeopardized due to various reasons such as large number of students in each class, laboratory activities and workshop practices and shortage of resources and supporting facilities, shortage of experienced and qualified teachers. They also add other problems such as lack of motivation from the side of teachers and academic background of students. Both teachers and students do not believe that they are doing the right things. Many of the teachers teach to finish what they have to teach; similarly many of the students learn just to pass examination. However, it seems that both teachers and students share the same grief and take the blame to the incapability of the system to improve it. Poor delivery in teaching, poor assessment mechanism, shallow student learning and things like these, in most cases seem to characterize the system, at least in the institutions into which this research was undertaken.

In conclusion one can say that the aim and focus in reforming engineering education is to produce engineers that are endowed with the knowledge, skills, and attitude that would enable the graduating engineers to solve engineering problems and contribute towards the economic and social development of the country. The variation in the perception of the engineering curriculum tends to divert the aim and the focus in the teaching and learning to different direction. As there are teachers who believe and assume that engineering education has to produce engineers who are capable of synchronizing the theoretical knowledge with that of the skill to solve engineering problems, there are also teachers who believe that the main focus in engineering education should be the theoretical aspect rather than it is a practical one. Implementing engineering education based on the first perspective reflects the importance of both theory and practice. On the contrary implementing engineering education based on the second perspective focuses on producing engineers with good background of theory and analysis. So the prevalence of such a varying situation somehow tends to limit the implementation of the reformed curriculum as it was planned. This then implies the need for creating more awareness and continuous training and retraining of teachers with regard to the aims of the reformed engineering education and the changes accompanying it.

8.4. What has influenced the engineering curriculum development process and its implementation?

Curriculum development and its implementation always take place within a society. There is no curriculum development or implementation without society. But society is endowed with a culture of its own which may be a fertile ground for a new idea or an impenetrable rock to the other. Any practice of curriculum development and its implementation has to consider this as much as possible. It is already mentioned that the initiative for engineering education and curriculum reform took place at top level. Teachers' participation in initiating the change aspect was not significant. As far as the findings of this research are concerned, the initiative for reforming engineering education and its curriculum development were influenced by many factors which include the government's needs for a new way of addressing engineering education, to provide higher education, especially engineering education to a large number of young people and the need for the introduction of new ideas in the structure of engineering education. The demanding nature of the growing industry which is expressed in terms of the need for engineers that are knowledgeable, skilled and who can translate their knowledge and skill in the work situation also received top priority among others in the ideas of reforming engineering education and engineering curriculum.

On the other hand, internal factors such as low number and quality of teaching staff which can be expressed in terms of the qualification they have, i.e., Bachelor degree, Masters degree, and PhD, low standards of the teaching learning situation that can be expressed in terms of insufficient and inefficient laboratories and lab equipments, the large number of students in both class and laboratory sessions were among the top factors that have influenced the implementation of the curriculum below the expectations at the institution level. Students' behavior which is expressed in terms of their low ability in mathematics and in the sciences including their preference of choosing easy and shallow ways of study to pass their examination, teachers' behavior that is expressed in terms of their absenteeism from their classes and their reluctance to give timely feed-back on assignments and group works are also among the factors that influenced the implementation of the engineering curriculum at the institution level, especially in the institutions where this study has taken place.

Even though the intentions and the actions taken in reforming engineering education at the top level in terms of decisions, particularly in curricular decisions including the preparation of the framework for the curriculum development were promising at the outset, its implementation in the institutions covered in this study, still lags behind and instigates doubts on the knowledge, skill, and the capability of the engineers trained under this curriculum. This implies that there is a need for looking deep into what is happening within the institutions and make corrections of whatever in order to attain the objectives stipulated in the reformed curricula, which is a matter of more effort and resource.

The reformed engineering curriculum is full of new and imported ideas which are not familiar to the teachers. The inclusion of new ideas in the curriculum is good, but the problem lies with the teachers understanding of it. It is now seven years since the implementation of engineering curricula took place in this country. Yet, as the findings of this research reveal there are teachers who cannot tell what is meant by ECTS, the idea of "holistic examination" and others. This implies that there is a wide gap between the teachers' knowledge of the details of the curriculum and what they are implementing. Moreover, it implies that there is lack of follow-up activities with respect to the proper implementation of the curriculum in general.

In other words, the teaching and learning process is being endangered and probably fails to produce the needed engineers in terms of quality which is expressed in terms of what the graduates know and what they can do, as the result of different factors such as teachers' absenteeism from their teaching duties, application of inappropriate methods of teaching and assessment, insufficient and inadequate set-up of laboratories and workshops, and shortage of teaching and learning materials.

In summary, it can be concluded that teachers in engineering education do not seem to have a full grasp of the ideas of the reformed engineering curriculum and the changes accompanying it. For instance, if you ask two or more teachers about the purpose of a "modularized curriculum" or "ECTS", they don't give you similar answer, yet they all tell you that they are teaching the modularized curriculum. As revealed in the findings of this study, many of the teachers, with the exception of few, stick to the old methods of teaching which is "chalk and talk", paper and pencil assessment mechanism, and less or no provision of feedback to students. This implies that there is distance between the teachers and the ideas of the curriculum.

8.5. How do stakeholders assess their involvement in curriculum design process and its relevance? What are their expectations of the new engineering graduates in terms of their knowledge, skills, and commitments?

There are many stakeholders who directly or indirectly claim that they have stake in engineering. Every development sector, public institutions of different nature, professional societies and many others need the use of engineering. Financing agencies and government organizations always need the good service of engineering as a field and engineers as individuals. Industry obviously is one of the primary stakeholders that demand more than anything appropriate competencies of engineering which is expressed in terms of engineering knowledge and skills for its tasks of manufacturing or services. Engineering teachers and students are also among the primary stakeholders as they are directly involved in the teaching learning process of engineers. Hence, the major focus in this part of the study is on the experiences of engineering teachers, industry, and students.

Engineering teachers feel that decisions about curriculum are not in their hands. What they do as teachers, especially these days, depend on someone's decision. Changes in curricula are decided without their knowledge, especially in ASTU which is one of the institutions involved in this study. Any suggestion they put forward is not acceptable. As the findings of this study indicate, participation at the initial stage of the engineering curriculum reform was relatively better than the participation in the latter years. As a number of participants indicated participation in curriculum development to most of the teachers is no more than preparing materials for student learning and teaching classes. On the other hand, students as stakeholders, have no say at all with regard to matters related to curriculum development.

The findings of the study also reveal that industry as one of the stakeholders of engineering does not play a major role in curriculum development. So far, it does not seem that the industry has influenced significantly in curriculum development in general. Experiences in other countries show that professional societies in the different areas of engineering exert an immense influence on what happens in engineering and technological education. Engineering education accreditation agencies are also the other part of such influence in other countries (e.g ABET, Washington Accord, and others). Influences such as these ones do not seem to exist in the context of Ethiopia so far. As revealed in the findings of this study, sometimes, some industry representatives are invited to some workshops to suggest and give some feedback on a newly developed curriculum. In most cases, the suggestions and feedbacks they give on such occasional invitations is regarded as participation in curriculum development and this is the most they can do in matters of curricula and curriculum development. However, they are not satisfied with that kind of participation and relationship only. What a participant of this study, from one of the industries, indicated herein below shows how they are concerned with the curricular natter.

> *Now we have the latest technology and we know what it looks like and we use it. They have included the old things. For example, you don't teach about ICDN these days because the ICDN these days is becoming out. I am telling you an example; there was something like this in that curriculum. This was one of the gaps I have observed in the curriculum* (Ind 1: p. 481).

In summary of this part it can be said that teachers are in the forefront of implementing curriculum. They are the ones that give life to the ideas of the curriculum and who strive for bringing change in the students' body in terms of having knowledge and skills and the capacity what they want to do. But teachers' efforts bear fruit if they themselves have a clear idea of the curriculum and the purposes attached to it. Improving the curriculum development process and its practices without availing the tools to teachers, which is the basic essence, knowledge, and understanding of the change in curriculum does not assure the highest level of curriculum implementation which in the final analysis is expressed in terms of the quality of the students' learning. As far as the findings of this study are concerned, the approach in the process of curriculum development is top-down. Most of the ideas (e.g., modular approach, ECTS, and others) are new to teachers. Even though some efforts were made to introduce and acquaint teachers with the reformed engineering curriculum it seems that there is gap between the intentions expressed in the curriculum and what is practiced at the classroom level as a result of not grasping the essence of the reformed curriculum and partly due to some other related reasons.

In summing up all together, this researcher believes that the analysis of the empirical results has provided insights into the various issues of the engineering curriculum development and consequently to the students' learning. As a result of this qualitative analysis, important conclusions are drawn which have implications for the improvement of engineering curriculum development and for students' learning. Accordingly the following conclusions are made.

The intention in engineering curriculum development and reform was to produce highly knowledgeable and skilled work force that serve the industry and support the development efforts of the country. However, the findings of this study reveal that its implementation effort, so far, do not seem to guarantee the results sought in terms of the quantity and quality of students' learning of the needed knowledge and skill. As revealed in this study engineering curriculum development was a top-down process that involved low participation of teachers in decision making, that is, in determining what must be included in the curriculum and how it should be developed and implemented. The teachers' law participation in curriculum decision making (mainly in ASTU) in terms of what to include in the curriculum and how to develop it at the outset of the curriculum development process, seems to have negatively impacted the subsequent implementation of the curriculum. Improper and low understanding of the newly introduced ideas of the reformed curriculum, that is, the importance and application of continuous assessment, the use and importance of ECTS and some other related ideas left implementation to have a poor stance and have resulted in low commitment of teachers in their practices of teaching and assessment. As a result the traditional ways of assessment and teaching methods still persist and dominate the whole process of the teaching learning within the institutions included in this study.

The perspectives of engineering curriculum as a discipline to be mastered and as transmission of content, which is held by many of the engineering teachers, is one of the barriers to the teaching and learning process of engineering education at present. Improving engineering curriculum development requires changing the perspectives of engineering education as a 'transmission of content' to development of skills that support engineering thinking and professional development. The findings of this study show that teaching and learning, as observed by the participant teachers and students in this study, mainly depended on classroom chalk-and-talk approach. This suggests the need to change such perspectives through continuous professional development of teachers

As the findings of this study also indicate, less motivated teacher behavior, expressed in teacher absenteeism and lack of providing feedback to students, is the other crucial barrier for the proper implementation of the curriculum in engineering education within the institutions. Implementing engineering curriculum and improving students' learning requires the unreserved service of motivated teachers who can accomplish the goal of teaching and learning effectively. Even though the issue of motivation is complex enough, as one of the means to improve their motivation, their remuneration needs have to be considered and addressed to minimize their dissatisfaction in their work of teaching. Teachers in engineering education have little or no training in teaching. This has limited the teacher's capacity of teaching and assessment and gave the option to stick to the traditional approaches in their teaching and assessment activities. In order to create a strong cadre of engineering education and to facilitate innovative abilities and lifelong learning attitudes in students, in the first place, the process of employing teachers of engineering, within the institutions, has to be considerate of additional criteria other than high scores upon their graduation. Such criteria may include the individual's possession of interest in the teaching profession and his or her ability in communication skills. Secondly, during and/or after the employment of the teaching staff, there has to be an established means that supports their continuous professional development and improve their teaching work in all aspects.

8.6. Recommendations

Improving curriculum development and consequently students' learning in engineering education is neither a straightforward explicit process, nor does it involve only a single party such as that of teachers, students, or curriculum developers. As the findings of this research showed, a number of intermingled factors influence curriculum development and students' learning in engineering education. In general, the curriculum development process and students' learning are complex, dynamic and multivariable processes that require a holistic approach to deal with. It is very difficult to single out one "right" model of curriculum that would ensure effective students' learning. The global demands of engineering education, the changing nature of technology, the changing demands of industry, the various curriculum perceptions of teachers and others, the differences in methods of delivery and assessment, individual characteristics of teachers and students, teacher and student motivation, availability of resources and other influences which might in general be categorized as external and internal factors need to be taken into account to facilitate and improve curriculum development and students' learning.

All of these, however, cannot be addressed and get an absolute solution with a single instance of intervention such as the recommendations made in this study. While the findings of the study specifically refer to the institutions into which this research is conducted, the recommendations made can be considered as an option in which policy makers, curriculum developers, IoT leaders, engineering teachers, and others may consider in their pursuit to improve the current status quo of the engineering curriculum development and students' learning. The different factors in the engineering education institutions and the cultural milieu into which the institutions exist may require different approaches to deal with their own particular situations. It would be difficult to assume that these set of recommendations would provide solutions to all contexts or to all persistent problems. Neither the assumption to develop an exhaustive list of strategies nor to attempt to readily provide solutions to all of the complex problems in the Ethiopian engineering education system could be anticipated within the scope of this research. Based on the research objectives, the empirical findings and the theoretical considerations, a number of recommendations are forwarded which may serve as strategic options and framework of actions for improving engineering curriculum development process and students' learning. The conclusions made in this research broadly suggest five major areas that help to bring about improvement in engineering curriculum development and students' learning. These major change areas for improvement are: the need for more involvement of teachers in curriculum development, initial and continuous teacher preparation and the creation of more awareness, creation of links with industry, improvement of the teaching and learning situation, and establishment of a strong assessment policy are needed within the institutions.

The implementation of these recommendations require a systemic approach and collaborative effort of engineering teachers, institution leaders, industry, Ministry of Education and other stakeholders in the education and economic sectors. As engineering curriculum development process is a long term process beginning from the initial learning and continuing throughout the development of the engineers' profession, it is critical to adopt a long term perspective and a systemic approach as opposed to fragmented and temporal changes and reforms in the implementation. The recommendations made under each of the three major areas of change are presented as follows.

8.6.1. The Need for more involvement of teachers in curriculum development

Curriculum improvement is not only a matter of putting new ideas and suggesting new ways of implementing it. The findings in this study show that teachers were called to adopt curriculum ideas that were sought more important than the traditional methods. For the last six, seven years they have been trying to do it as they have been told. Still it appears that most of them have not yet owned it and seem that they do not understand a significant part of it. For this reason they stick more to the traditional methods of doing it. Owning the curriculum from the side of teachers is the most important aspect for proper implementation of the curriculum. As the findings of this research revel, currently there seems to be a wide consensus among teachers on externalizing the problems of curriculum development and its implementation. No matter how well the curriculum document is prepared and no matter what progressive ideas it contains, without the teachers' belief in it and their devotion and commitment to implement it, it is likely that the results would be below what is sought and this seems true in the institutions into which this study is undertaken. This is manifested in two inseparable ways. The first one of these is lack of attention to grasp the essence of the curriculum and what it requires. The other side is to regard teaching simply as fulfilling the obligation that is prescribed by someone outside. Inherent in both of these manifestations is lack of a sense of ownership. This clearly shows that teachers' participation in curriculum development is not to the level it develops their sense of ownership of the curriculum. Hence, it is recommended that teachers have to be part of the decision making process and have a look into the alternatives to be able to choose the most important aspects of engineering education from the outset, rather than being told to fit into a prescribed curriculum.

8.6.2. Provision for initial and continuous teacher preparation and more awareness creation of curriculum change

One of the major areas where change is necessary for improving engineering curriculum development and the practices of teaching and learning is the creation of more awareness and more understanding of the new directions and requirements of engineering education and curriculum. Another area that needs improvement in connection with teachers is their professional development as beginners and as seasoned teachers. Changes in society and technology require continuous adjustment which implies continuous learning to get along with the changes and this is particularly important in engineering education since it is directly connected with the fast changing rate of technology in this era. To cope up with these changes it needs a cultural change of teaching and learning. Without having the background knowledge and skill of teaching and learning it would be difficult for teachers to identify the proper way of implementing the curriculum. To this end, engineering institutions should aim to develop an initial engineering teacher training and continuous teacher professional development mechanism for engineering teachers that can provide the knowledge and skill of teaching and learning, to progressively update and upgrade the teachers' knowledge and skill of teaching and learning, including the mechanisms of assessment.

The approach, by which teachers were taught, is one of the crucial determinants of how they are approaching teaching and learning including assessment of students' learning. With the exception of some attempts of providing limited training in a generic form, knowledge and skill in teaching and assessment of students' learning was not a requirement in engineering teaching in the past. Teachers taught students with their initial background of technical knowledge and skills of engineering sciences and mathematics without having any formal orientation, knowledge and skill of teaching. Though many of such teachers were capable of learning how to teach and assess students through their career of teaching, by themselves, it cannot be said that all engineering teachers are moving towards more of the application of active teaching and learning methods, which are the demands of teaching learning in the modern era, in general. Putting all teachers in this direction, however, may not be possible overnight. But one of the crucial means to bring change in this direction could be with a special institutional effort dedicated to engineering education. It requires a concerted effort of shared leadership and empowering engineering teachers to take the lead in setting the teacher professional development goals and implementation and by creating forums for individual engineering teachers and professional development teams that provide opportunities for learning from each other through discussion, reflection, and critical discourse.

8.6.3. Creating strong link between engineering education institutions and industry

Engineering education creates individuals who ultimately be connected to work in industry. Engineering graduates are the ones who have to strive for the technical functioning, minimizing cost, and the continuous adaptations of new technologies in industry. Industry needs the engineers if they are capable of doing the work it needs. The proper functioning of the industry benefits both industry and engineering graduates. However, for producing engineers who are capable of doing the work in industry, the effort of the education institutions alone is not enough. Industry is always closer to the findings and development of new technology and to implementing it in a rate faster than the educational institutions would think of introducing it in their education system. In this sense, educational institutions lag behind. So, for the proper functioning of the educational institutions, information from industry is crucial. On top of this, research findings which have to be conducted within the institutions, direct information related to the needs of industry would keep the educational institutions abreast. So far, as the findings of this study indicate, the relationship between industry and the educational institutions is very limited and occasional; lacking formality. It appears that the purpose of creating the needed engineers is left out to the educational institutions without any significant input from the industry. Hence, it would be crucial to form a strong link between industry and the educational institutions beyond the occasional meetings and the internship relationships. To this end, engineering institutions should aim at:

- Establishing legally supported permanent forum between the educational institutions and industry whose aim is liaison between both the needs of industry and the contents of courses in the educational institutions;
- Cooperation with industry and using the potentials of industry for the education and training purposes.

8.6.4. Improving teaching learning situation using various options

Though undergraduate engineering students, in most cases, have to concentrate on learning the fundamental knowledge and the thinking skills of engineering sciences and other subjects related to it, they also need to know how to apply this in the practical situation of work and be able to solve prevailing and new problems. Their ability to do this by large depends on how well they learn and test the methods of synchronizing the theory with practice within laboratory or other similar situations. This in turn requires the availability of a situation conducive to teaching and learning which is expressed in terms of availability of working and testing equipment and materials, availability of sufficient space for individual students to practice with and availability of well qualified teaching staff that can guide the practices. To this end, institutions have to make the utmost effort in establishing and fulfilling the basic requirements of laboratories and workshops for each of the particular fields of studies in any way possible. This may include:

Alternative One: - establishing and equipping laboratories within each of the technology institutions and availing to students learning within it. This may be the most preferable way as it gives better opportunity for students to learn within a close vicinity of their campuses without involving longer trips to other places.

Alternative Two: - forming a cluster of institutions that avail the existing laboratories, workshops, and the equipments within them to share and use cooperatively in a planned way. This may obviously involve additional effort and cost in transporting students from their campuses to the institution where the laboratories and workshops exist. But in terms of engineering education, it is much better than leaving students without having the practical component of a course or courses.

Alternative Three: - Arranging a special arrangement with industries that possess laboratory, workshop arrangements, and equipments that are different from what the institutions have and use these for students' learning. This, on top of its additional advantage of giving opportunity to the students in terms of knowing the reality of work situation, it serve as a means to fill the gap between what the institution has and what the learning of the specific courses require. But it may incur, probably more effort and cost, like the case in Alternative Two mentioned above, but it is still much better than graduating students without having touched those equipments and without having some practice on them as per the requirements of the course.

8.6.5. Improving the assessment process

The process of assessment in engineering education deals with finding out the efficiency of the teaching learning process in creating students who have knowledge of engineering and related sciences and capable of translating these into a real work situation. Even though the act of conducting assessment takes place in a group situation, the results of assessment should speak of the individual students. Assessment results have to provide information about each individual's possession and understanding of the knowledge and his/her ability of translating this knowledge into practical situation. Assessment, in any formal education, requires individual task or tasks performed in groups, under tight control of the teacher, and has to provide evidence of each student's learning of the subject and his/her ability of translating the knowledge into work situation. The current assessment practice, in many ways, seemed to fail to measure the actual performance of each student and, thus, needs a closer attention from the side of the institutions. To this end, institutions have to create a mechanism that:

- requires students to involve in deep learning, understanding of the subject matter and ability of translating the subject matter into a real work situation rather than shallow learning which is targeted simply to pass examination.
- differentiates those assignments, quizzes and practice projects that are performed for learning purposes and those used for making decision about individual students' learning.
- ensures the reliability of the assessment values provided to each of the students to reflect the actual or the true performance of each student.
- ensures the authenticity of each individual's piece of work that counts for the purpose of determining the students' relative stance among the whole group of students.

8.6.6. Research in the future

As yet, very limited or no research has been conducted with regard to engineering education in a comprehensive form within the context of Ethiopia. This implies that there is a long way to go in the future along this side. Engineering education at present has become the top priority in higher education. Hence, it requires not only qualified teachers, but also more gratified of researchers who would pinpoint the strengths and pitfalls that may facilitate or jeopardize students' learning. Findings of educational research should play the role of alerting institutions in terms of the current situation and the demands of engineering education and how to deal with it in a teaching and learning situation. Since the ultimate goal of providing engineering education is to make sure the production of appropriate and skillful human resource who strive for the development of innovation and for suggesting better ways of improving the engineering process, research findings along this line could be helpful for leaders of the institutions, teachers and students. In view of this, engineering education institutions and teachers are recommended to aim for conducting research on the following and other related topics.

- The Extent to which active learning methods are applied in engineering education and its effects on student learning.
- Teachers' perception and understanding of modular curriculum in engineering education.
- The application of continuous assessment in engineering education; its advantages and disadvantages for students' learning.
- The teaching learning and assessment process of selected engineering courses (modules) and its implication to students' learning.

Bibliography

› T [›eÑÊU (2002 ¯.U) “¾Ÿõ }— ƒUI`ƒ Y`¯} ƒUI`ƒ ›Óvw’ƒ“ **የመማሪያ ግብዓቶች ይዞታ**“ in Quality of Higher Education in Ethiopian Public Institutions, (pp. 57 – 93) Addis Ababa: Forum for Social Studies.

A World Bank Sector Study (2003), Higher Education Development for Ethiopia: Pursuing the Vision, Document of the World Bank, January 20, 2003.

Aamodt, A. M. (1982) Problems in Doing Nursing Research: Developing a Criterion for Evaluating Qualitative Research, *West J Nurs Res FALL 1983 vol. 5 no. 4 398-402*

AAU, (2008), Student Handbook, Addis Ababa: Office of the Registrar.

AAU, (2011), Library Link, AAU Libraries Newsletter, Volume III Issue II, January 2011

AAU, (2012), Reorganization of Structural Set-up and Governance System of the University, Part I, March 2012.

ABET (2010), Board Rules and Regulations Relating to the Practices of Professional Engineering and Land Surveying, California Code of Regulations, Title 16, Division 5 §§ 400-476, Article 1. General Provisions.

ABET (2010), Criteria for Accrediting Engineering Programs: Effective for Evaluations during the 2011-2012 Accreditation Cycle.

ACQUIN (2007), Evaluation Report, unpublished paper.

Council of Ministers, (2006). Adama University Establishing Council of Ministers, Regulation No. 120/2006, Addis Ababa, 23rd January 2006.

Adams, M. et al., (2011). Multiple Perspectives on Engaging Future Engineers, Journal of Engineering Education, January 2011, Vol. 100. No. 1, pp. 48-88.

Adelman, C. (2009). The Bologna Process for U.S. Eyes: Re-learning Higher Education in the Age of Convergence.

Akker, Jan van den, Wilmud K., and Uwe, H., eds.,(2003), Curriculum Landscapes and Trends. Dordrecht: Kluwer Academic Publishers.

Alemayehu B. and Lasser, J. (2012). Education in Ethiopia: Past, Present and Future Prospects, African Nebula, Issue 5, 2012, pp. 53-69, *http://nobleworld.biz/images/5-Lasser_s_paper.pdf*

Altrichter, H. and Eillott, J. (eds.) (2000), Images of Educational Change, Buckingham • Philadelphia: Open University Press.

Amare A. (2005). Higher Education in Pre-Revolution Ethiopia: Relevance and Academic Freedom, The Ethiopian Journal of Higher Education Vol. 2 No. 2 December 2005.

Amare, A, (2004), Debates in Research Paradigms: Reflections in Qualitative Research in Higher education, The Ethiopian Journal of Higher education, Vol. 1. No. 1 June 2004 (pp. 41 – 61).

Amare, A. (1998), "Culture and Development" sited and quoted in Woube K., (2000) "The Need for Analyzing Culture in Planning Curriculum" IER FLAMBEAU, Volume 11, Number 2, June 2004.

Amare, A. (2000), A Welcome speech delivered to an audience of a conference at AAU conference Hall. August 11–12, 2000.

Ambrose, S. A. (2013), Undergraduate Engineering Curriculum: The Ultimate Design Challenge, The Bridge, Vol. 43, No. 2, Summer 2013, National Academy of Engineering

American Society for Engineering Education (2010), The Green Report – Engineering Education for a Changing World, Washington D.C., web: www.asee.org

Asres, B. (n.d.), Addis Ababa University: General Information, Addis Ababa University, Office of External Relations, Partnership and Cooperation.

ASTU, (2007). Study Program for the Degree of Bachelor of Science (B.Sc.) in Civil Engineering. Department of Civil Engineering, ASTU

ASTU, (2011), Five-Year Strategic Plan (2011/12-2015/16) September 2011.

ASTU, (2011). Undergraduate Curriculum. Department of Mechanical and Vehicle Engineering, ASTU.

ASTU, (2012), Senate Legislation, Adama Science and Technology University, January 25, 2012

AU, (2007a), Study Program for the Degree of Bachelor of Science (B.Sc.) in Civil Engineering, Faculty of Engineering, Department of Civil Engineering.

AU, (2007b), Study Program for the Degree of Bachelor of Science (B.Sc.) in Mechanical Engineering, Faculty of Engineering, Department of Mechanical Engineering.

Ayalew, S. (1982), An excerpt from "Planning Issues Identifiable by Qualitative Analysis of the Ethiopian Education System (unpublished Master's Thesis), University of Bristol.

Ayalew, S. Dawit M., Tesfaye S. and Yalew E. (2009), Assessment of Science Education Quality Indicators in Addis Ababa, Bahir Dar and Hawassa Universities, Addis Ababa: Forum for Social Studies.

Ball, S. J. (1999). Global Trends in Educational Reform and the Struggle for the soul of the Teacher, Paper Presented at the British Educational Research Association Annual Conference, University of Sussex at Brighton, Sept., 2-5.

Barnett, R. & Coate, K. (2005), Engaging the Curriculum in Higher Education, UK: Open University.

Barnett, R. (edit.) (2005), Reshaping the University: New Relationships between Research, Scholarship and Teaching, Society for Research into Higher Education & Open University Press.

Baxter, P. & Jack. S. (2008), Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers, *The Qualitative Report* Volume 13 Number 4 December 2008 544-559 http://www.nova.edu/ssss/QR/QR13-4/baxter.pdf

Bayou, Tenagne, Buhler, and Oswald (2006), AAU: Faculty of Technology Curriculum Reform, Book I, Introduction, Addis Ababa, 2006.

BDU, (2007), Study Program for the Degree of Bachelor of Science (B.Sc.) in Electrical Engineering. Faculty of Engineering, Department of Electrical Engineering.

BDU, (2007), Study Program for the Degree of Bachelor of Science (B.Sc.) in Mechanical Engineering. Faculty of Engineering, Department of Mechanical Engineering.

BDU, (2007), Study Program for the Degree of Bachelor of Science, (B.Sc.) in Civil Engineering. Faculty of Engineering, Department of Civil Engineering.

Beauchamp, G. A. (1982) Curriculum Theory: Meaning, Development and Use. Theory into Practice, Vol. 21, No. 1, Curriculum Theory, (winter, 1982), pp. 23-27, Taylor & Francis, Ltd.

Beyer, L. E & Apple, M. W. (edits) (1998), The Curriculum: Problems, Politics, and Possibilities, U.S: State University of New York.

Biggs, J. (2003), Aligning Teaching and Assessment to Curriculum Objectives, Learning and Teaching Support Center.

Biggs, J., & Tang, C. (2007), Teaching for Quality Learning at University (3rd ed.), Society for Research into Higher Education & Open University Press, McGraw Hill.

Blackmore, P & Kandiko, C. (2012), Strategic Curriculum Change: Trends in Universities, USA and Canada: Routledge.

Bleiklie, I. (2004), Diversification of Higher Education Systems: in Papers produced for the UNESCO Forum Regional Scientific Committee For Europe and North America, Paris, March 2004 (pp 17 – 39).

Bloom, D. Canning. D. and Chan, K. (2006), Higher Education and Economic Development in Africa, Human Development Sector, Africa Region

Bloom, D., Canning, D. & Chan, K. (2005), Higher Education and Economic Development in Africa, Harvard University

Bordogna, J., Fromm, E. and Ernst, E. W. (1995), An Integrative and Holistic Education, Journal of Science Education and Technology, Vol. 4, No. 3, 1995

Borrego, M. et.al, (2009), Quantitative, Qualitative, and Mixed Research Methods in Engineering Education. Journal of Engineering Education 98 no1, January 2009, pp 53-66.

Boyce, C. & Neale, P. (2006), Conducting In-depth Interviews: A Guide for Designing and Conducting In-Depth Interviews for Evaluation Input, Pathfinder International Tool Series Monitoring and Evaluation–2

Braslavsky, C. (2000), The Secondary Education in Curriculum in Latin America: New Tendencies and Changes, Brennan, J. King, R. and Lebeau, Y. (2004), The Role of Universities in the Transformation of Societies: An International Research Project Synthesis Report, London: Association of Commonwealth Universities.

Brent, R & Felder, R. M. (2003), A Model for Engineering Faculty Development, Intl. Journal of Engr. Education, 19*(2), 234–240 (2003).*

Brinkmann S. & Kvale, S (2005), Confronting the Ethics of Qualitative Research, *journal of constructivist psychology*, 18:157–181, 2005, Taylor & Francis Inc.

Brown, G. with Bull, J. and Pendlebury, M. (1977), Assessing Student Learning in Higher Education, New York: Routledge.

Campbell, D.A. et al. (2007), Balancing Pedagogy and Student Experience in First-Year Engineering Courses In Proceedings of the 3rd International CDIO Conference, MIT, Cambridge, Massachusetts, USA, June 11-14, 2007

Campbell, J. R. (2012), Building an IT Economy: South Korean Science and Technology Policy, Issues in Technology Innovation, Number 19, Executive Summary, Troy University, September 2012.

Carew, A. L., Wickson, F. & Radcliffe, D. (2006), Lessons from transdisciplinarity studies in the design and evaluation of engineering education research. AAEE - Annual Conference of Australasian Association for Engineering Education (pp. 1-7). Auckland, NZ: Australasian Association for Engineering Education.

Case, J. M. and & Light, G., 2011). Emerging Methodologies in Engineering Education Research, Journal of Engineering Education, January 2011, Vol. 100, No. 1, pp. 186–210 http://www.jee.org

Cheng, Y. C. (2005), New Paradigm for Re engineering Education: Globalization, Localization and Individualization, Series: Education in the Asia-Pacific Region: Issues, Concerns and Prospects, Vol. 6

Chism, N. V. N. et al. (2008), Qualitative Research Basics: A Guide for Engineering Educators, Rigorous Research in Engineering Education, NSF DUE-0341127, 2008.

Clark, B. & Neave, G. (1992), The Encyclopedia of Higher Education, Vol. 3, Oxford, New York, Sequl, and Tokyo: Pergamon Press.

Clark, John A. (1995), Ethical and Political Issues in Qualitative Research from a Philosophical Point of View. Paper presented at the annual Meeting of the American Educational Research Association (San Francisco, CA, April 18 – 22, 1995)

Cloete N, Bailey T, Pillay P, Bunting I & Maassen P, (2011), Universities and Economic Development in Africa. CapeTown: Centre for Higher Education Transformation.

Cloete, N. Bailey, T. and Maassen, P. (2011), Universities and Economic Development in Africa Pact, academic core and coordination Executive Summary of Synthesis Report. Wynberg: COMPRESS.dsl | www.compressdsl.com .

Cohen, Solomon, (2008), Long Range Perspectives for the Education Sector: Ethiopia Roadmap Report, Report Prepared for the Ministry of Education, Ethiopia, and the UNDP, DAG Secretariat, 1st September 2008.

COPERNICUS-CAMPUS, *COPERNICUS-Guidelines for Sustainable Development in the European Higher Education Area:* How to incorporate the principles of sustainable development into the Bologna Process, www.copernicus-campus.org.

Cordier, H. (2007), The Future of Higher Education in the Field of Technology in Ethiopia- with Special Focus on Governance Issues. ECBP, with contributions by the Task Force "Governance" of the Faculty of Technology at Addis Ababa University, A Draft document.

Cornbleth, C. (1988), Curriculum In and Out of Context, Journal of Curriculum and Supervision, winter 1988, Vol. 3, No. 2, 85-96.

Coyle, E. (2009), Engineering Education in the US and the EU. Chapter 5 in Engineering in Context. Academia, 2009.

Crauss, S. E. (2005), Research Paradigms and Meaning Making: A Primer, The Qualitative Report Volume 10 Number 4 December 2005 758-770

Crawley, E., Malmqvist, J., Ostlund, S., and Brodeur, D (2007), Rethinking Engineering Education: The CDIO Approach, New York: Springer Science Business Media, LLC

Creswell, J. W. (2003), Research Design Qualitative, Quantitative, and mixed methods Approaches (second edition), Thousand Oaks. London. India: SAGE Publications.

Creswell, J. W. (2007), Qualitative Inquiry Research Design" Choosing Among Five Approaches (2nd ed.) Thousand Oaks, London, New Delhi: SAGE Publications.

Davis, D.C. & Davis, I.T. (2005), Definitions, Comparisons, and Research Bases *Journal of Engineering Education* April 2006. Delhi: SAGE Publications.

Davis, M. H (2003), Outcome-based education, JVME 30(3) ©2003 AAVMC. http://www.utpjournals.com/jvme/tocs/303/258.pdf

Demis, A., Alem, B. Daniel, K. and Edessa, D. (2006), AAU Faculty of Technology Curriculum Reform, Book III, Department of Mechanical Engineering Addis Ababa, 2006, Printed at CCC, Münster, Germany..

Denzin, N.K., & Lincoln, Y.S., (1994), Introduction: Entering the Field of Qualitative Research, in Denzin, N.K., & Lincoln, Y.S. (eds.) Handbook of Qualitative Research. Thousand Oaks, CA: Sage.

Derebssa D. (2006), Issues in the Implementation of Ethiopian School Curriculum, Medawalabu University.

Dolence, M. G., (2003), The Learner – Centered Curriculum Model: A Structural Framework for Technology Planning. EDUCAUSE Centre for Applied Research, Research Bulletin Volume 2003, Issue 17, August 2003.

Doll, R. (1989), Curriculum Improvement: Decision Making & Process (4th ed.), Boston: Allyn & Bacon.

Donnelly, K. (2007), Australia's adoption of outcomes based education: A Critique, Issues in Educational Research, 17(2), 2007

Dorsch, N. G. & Jackman, D. H. (The Politics Of Standards-Based Curriculum In A Course-Based Environment Journal of College Teaching & Learning, Volume 1, Number 4, (pp. 43 – 50), Northern Illinois University.

Drebssa, D. S. (2006), Tension Between Traditional and Modern Teaching-Learning Approaches in Ethiopian Primary Schools, CICE Hiroshima University, Journal of International Cooperation in Education, Vol. 9, No 1, (2006) pp.123-140

Ducote, J. M. (1985)' Curriculum in Higher Education: Historical Influences and Curricular Models. Paper presented at a Meeting of the Mid-South Educational Research Association (Biloxi, MS, November 6-8, 1985).

Duderstadt, J. J. (2008). Engineering for a Changing World: A Roadmap to the Future of Engineering Practice, Research, and Education. The Millennium Project, The University of Michigan.

Dym, C.L., Gogino, A. M. A, Eris, O. Frey D. D., and Leifer, L. J. (2005), "Engineering Design Thinking, Teaching, and Learning", Journal of Engineering Education, January 2005, (pp. 103 – 120)

Dyrenfurth, M. Murphy, M. & Grimson, W. (2009), Implications of Philosophy for Engineering and Engineering Technology Bachelors Programs, Proceedings of INTED2009 Conference 9-11 March 2009, Valencia, Spain.

ECBP, (2009), Framework and Change Management Concept for Setting up Institutes of Technology in Ethiopia. Addis Ababa, 26th June 2009.

ECBP, (2010), Five Years Strategic Plan (2003 – 2007), Zero Draft. April 2010. Education, Audiovisual and Culture Executive Agency, (2009).Higher Education in Europe 2009: Developments in the Bologna Process, ISBN 978-92-9201-023-2

El Maraghy, (2011), Future Trends in Engineering Education and Research: In G. Seliger et al. (eds.), Advances in Sustainable Manufacturing: Proceedings of the 8th Global Conference on Sustainable Manufacturing, DOI 10.1007/978-3-642-20183-7_2, © Springer-Verlag Berlin Heidelberg 2011

Ellis, A. K. (2004), Exemplars of Curriculum Theory, New York: Rotledge.

Elwell, F. (1999), Industrializing America: Understanding Contemporary Society through Classical Sociological Analysis, West Port: Praeager Publishers.

El-Zein, Abbas et.al. (2008), Sustainability and ethics as decision-making paradigms in engineering curricula, International Journal of Sustainability in Higher Education, Vol. 9 No. 2, 2008 (pp. 170 – 181) University of Sydney, Sydney, Australia).

Ensor, P. (2004), Contesting Discourses in Higher Education Curriculum Restructuring in South Africa, *Higher Education*, 48, pp. 339-359.

Ernst, E. W. (1998), Review of Reports, Studies, and Conferences, In: Ernst, E. W. & Peden, I. C. (Conference co-chairs), Realizing the New Paradigm for Engineering Education, proceedings, June 3-6, 1998

Ethio-German Government Negotiations in Berlin, from (2005), Summary Record of the Ethio-German Government Negotiation in Berlin from 17 to 18 March 2005.

Ethiopian Economic Association EEA (2008), The current State of the Construction Industry, Report on the Ethiopian Economy, Volume VI, 2006/07, Addis Ababa.

Ethiopian Science and Technology Agency, (2006), Background Document for Revision of the National S&T Policy of Ethiopia, June 2006.

European Association for Quality Assurance, (2005), Standards and Guidelines for Quality Assurance in the European Higher Education Area, Helsinki, http://www.enqa.net/bologna.lasso.

FDRE, (1994), Education and Training Policy, Addis Ababa, April 1994.

FDRE, (2004), Report on the Development of Education in Ethiopia to the UNESCO Forty-Seventh Session of the International Conference on Education, 8 – 11 September 2004, Geneva, Switzerland.

Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia (2001), Proclamation No. 256/2001

Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia, (2003), proclamation No. 351/2003, 9th Year No. 72, Addis Ababa, 3rd July 2003.

Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia, (2009), Proclamation No. 650/2009, Higher Education Proclamation, 15th Year No. 64, Addis Ababa 17th September, 2009.

Felder R. M., Brent, R. & Prince, M. J. (2011), Engineering Instructional Development: Programs, Best Practices, and Recommendations, *Journal of Engineering Education*, *100*(1), 89 –122 (2011).

Felder, R. & Prince, M. (2007), The Case for Inductive Teaching: PRISM, Vol. 17(2), p. 55, October 2007

Felder, R. M. (2012), Engineering Education: A Tale of Two Paradigms, In: McCabe, B., Pantazidou, M., & Phillips, D., eds. (2012), Shaking the Foundations of Geo-Engineering Education, pp. 9–14, Leiden: CRC Press.

Felder, R. M. & Brent, R (2004), The Intellectual Development of Science in Engineering Students: Teaching to Promote Growth, *Journal of Engineering Education*, *93* (4), 279–291 (2004).

Felder, R. M. & Brent, R. (2003), Designing and Teaching Courses to Satisfy the ABET Engineering Criteria *Journal of Engineering Education*, *92* (1), 7-25 (2003).

Felder, R. M. & Brent, R. (2004), The ABC'S of Engineering Education: ABET, Bloom's Taxonomy, Cooperative Learning, and so on, Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition, American Society for Engineering Education 2004.

Felder, R. M. & Brent, R. (2004), The Intellectual Development of Science and Engineering Students: Part 1. Models and Challenges, *Journal of Engineering Education, 93* (4), 269–277 (2004).

Felder, R. M. & Brent, R. (2009) Active Learning: AN Introduction, *ASQ Higher Education Brief, 2*(4), August 2009

Felder, R. M. & Silverman, L. K (1988), Learning and Teaching Styles in Engineering Education, Engr. *Education, 78*(7), 674–681 (1988)

Felder, R. M. (1997), On Creating Creative Engineers, *Engineering Education, 77*(4), 222–227 (1997).

Felder, R. M. (2007), Research on Teaching and Learning in Engineering* (* Academy of Chemical Engineers Award Lecture, Department of Chemical and Biological Engineering, University of Missouri-Rolla, April 18, 2007.)

Felder, R. M. and Henriques E. R. (1995), Learning and Teaching Styles In Foreign and Second Language Education, Foreign Language Annals, 28, No. 1,1995, pp. 21–31

Felder, R. M. et al. (2000), The Future of Engineering Education II: Teaching Methods That Work, *Chem. Engr. Education, 34*(1), 26–39 (2000).

Flinders, D. J. & Thornton, S. J. (2004), The Curriculum Reader (2nd ed.), New York and London.

Fosnot, C. T. (2005), Constructivism Revisited: Implications and Reflections, The Constructivist, Fall, 2005, Vol. 16, No.1http://www.uen.org/utahstandardsacademy/math/downloads/level-1/3-1-ConstructivismRevisited.pdf

Fosnot, C.T. (edit.) (2005), Constructivism, Theory, Perspectives and Practice, (2nd ed.), New York and London: Teachers College, Columbia University.

Fraser, S. P & Bosanquet, A.M. (2006).The Curriculum? That's Just a Unit Outline, Isn't It? Studies in Higher Education, 31:03, 269-284.

http://dx.doi.org/10.1080/03075070600680521 (Accessed on 09 January 2014) Rutledge.

Fromm, E. (2003). The Changing Engineering Educational Paradigm, Journal of Engineering, April, 2003 (pp. 113 – 121).

Fry, H., Ketteridge, S. & Marshall, S (2009) (eds.), Understanding Student Learning: in Handbook for Teaching and Learning in Higher Education: Enhancing Academic Practice (3rd ed.), New York & London: Routledge, pp 8-26.

Fullan, M. (1989), Planning, Doing, and Coping with Change: in Moon, B., Murphy, P., and Raynor, J. (eds.), Policies for the Curriculum (pp. 183-211), London. Sydney. Auckland. Toronto: Hodder & Stoughton.

Fullan, M. (2006), Change theory: A force for school improvement, Victoria: Centre for Strategic Education, 2006.

Fullan, M. G. (1994), Coordinating Top-Down and Bottom-Up Strategies for Educational Reform, Systemic Reform, Perspectives on Personalizing Education-September 1994

Gale, et al, (2013), Using the framework method for the analysis of qualitative data in multi-disciplinary health research, BMC Medical Research Methodology 2013, 13:117 http://www.biomedcentral.com/1471-2288/13/117

Gao, S. Neilson, J. C. & Goscinski1, A. (2013), Constructivist Learning: Understanding and Experience in IT Tertiary Education, Journal of Curriculum and Teaching, Vol. 2 No. 2, 2013.

Giroux, H. A. (2015), Democracy in Crisis, the Specter of Authoritarianism, and the Future of Higher Education, Journal of Critical Scholarship in Higher Education and Standard Affairs: Vol. 1, Article 7. Pp. 101-113.

Glasersfeld (1998), Why Constructivism must be Radical, In: M. Larochelle, N. Bednarz & J. Garrison (eds.) Constructivism in Action, Cambridge, UK: Cabridge University Press, 1998, pp. 23-28.

Glasersfeld (2005), Introduction: Aspects of Constructivism, In: Fosnot, C. T. (2005), Constructivism: Theory, Perspectives, and Practice, Second Edition, Chapter 1.

Glasersfeld, E. V. (1989), Constructivism in Education, In: T. Husen & T. N. Postlethwaite, (eds.) (1989) The International Encyclopedia of Education, Supplement Vol. 1, Oxford/New York: Pergamon Press, 162-163.

Glatthorn, A. A. & Jailall, J. M. (2009), The Principal as a Curriculum Leader: Shaping what is taught and tested (3rd ed.), Thousand Oaks: Corwin Press, a SAGE company.

Gordon, B. M. (1984), "What is an Engineer?" Invited Keynote Presentation, Annual Conference of the European Society for Engineering Education (SEFI), University of Erlangen-Nürnberg: in (Crawley, et al. 2007: 11).

Gosper, M. and Ifenthaler, D. (eds.) (2014), Curriculum Models for the 21st Century: using Learning Technologies in Higher Education, New York: Springer. http://books.google.com.et/books?

Governance and Organizational Reform Taskforce Faculty of Technology, Addis Ababa University (2007), Draft Proposal for Governance and Organizational Reform of the Faculty of Technology (AAU) within the Framework of Engineering Capacity Building in Ethiopia. February 2007.

Grasso, D. & Burkins, M. B. (eds.) (2010), Holistic Engineering Education: Beyond Technology, New York: Springer Science+Business Media, LLC 2010

Gu, Peihua, et.al. (2006). The development of design directed engineering curriculum based on the CDIO framework, World Transactions on Engineering and Technology Education, Vol.5, No.2, 2006 (pp.267-270)

Guba, E.G (1981), Criteria for Assessing the Trustworthiness of Naturalistic Inquiries. Educational Communication and Technology Journal, 29, 75-92.

Guba, E.G., & Lincoln, Y.S. (1994), Competing Paradigms: In Qualitative Research. In: N.K. Denzin and Y.S. Lincoln (eds.), Handbook of Qualitative Research, London: SAGE publications. Pp. 105-117

Guri-Rosenblit, S. and Sebkova, H. (2004), Diversification of Higher Education Systems: Patterns, Trends and Impacts, Papers produced for the UNESCO Forum Regional Scientific Committee for Europe and North America, pp. 40-69, Paris, March 2004.

Guskey, Thomas (1992), the Implementation of Focusing on Student Outcomes, NCA Quarterly 66. No. 3 (1992).

Hammersley, M. and Atkinson, P. (1995), *Ethnography: Principles in Practice*, (Second Edition), pp 263-287, London, Rutledge.

Hancock, B., Ockleford, E. & Winderidge, K. (2009), An Introduction to Qualitative Research, The NIHR RDS EM/ YH, 2007

Hancock, Beverly (1998) (updated 2002), Trent Focus for Research and Development in Primary Health Care: An Introduction to qualitative Research, Trent Focus 1998.

Hancock, D. R. & Algozzine, B. (2006), Doing Case Study Research: A Practical guide for Beginning Researchers, New York and London: Teachers College Columbia University.

Hansen, R. E. (1995), “Five Principles for Guiding Curriculum Development Practice: The Case of Technological Teacher Education” Electronic Journal, Journal of Industrial Teacher Education, winter 1995 Volume 32 Number 2, University of Western Ontario.

Harald, J. (2012), Tribes, territories and commons in Teacher Education: Looking backwards in ten years with a mode 2 curriculum projects, The International Handbook of Cultures of Professional Development for Teachers: Strasbourg – France, pp. 393-415.

Hargreave, A. (2000), Four Ages of Professionalism and Professional Learning, Teachers and Teaching: History and Practice, Vol. 6, No. 2, 2000, pp. 151-182

Hargreaves, A. (1994), Critical Introduction, in I. Goodson (ed.), Studying Curriculum (pp. 1-11). Buckingham, UK: Open University Press.

Harlan, C (1974), The Little League and the Imperatives of Interdependence. Paper presented at the Annual Meeting of the National Association of State Universities and Land Grant Colleges (Washington, D.C., November 1974)

HELENA Consortium (2009), State of the Art: Curriculum Research in Engineering, HELENA Deliverable D2.3. Place of Publication is not mentioned.

Hensen, R. E. (2001), Curriculum Planning, (2nd ed.) Boston: McGraw Hill

Henson, K. T. (1995), Curriculum Development for Education Reform, New York: Longman. http://scholar.lib.vt.edu/ejournals/JITE/v32n2/hansen.html

HESO report: Higher Education Strategy Overhaul Committee of Inquiry into Governance, Leadership and Management in Ethiopia's Higher Education System *(HESO)*.

Hewitt, Thomas W. (2006). Understanding and Shaping Curriculum: What we teach and Why, Thousand Oaks: Sage Publications, Inc

Heywood, J. (2005), Engineering Education Research and Development in Curriculum and Instruction, New Jersey and Canada: IEEE Press, A John Wiley & Sons, Inc., Publication.

Hicks, O. (2007), Curriculum in higher education in Australia, Higher Education Research and Development Society of Australasia Inc. Proceedings of the 30th HERDSA Annual Conference, 8-11 July.

Hlebowttsh, P.S. (2005), Generational Ideas in Curriculum: A Historical Triangulation, Curriculum Inquiry, Ontario Institute for Studies in Education of the University of Toronto (pp. 73 – 87).

Hooper, R. (1971), The Curriculum: Context, Design, and Development, Oliver & Boyed, Edinburgh in Association with the Open University Press.

Hoyle, E. (1971), How Does the Curriculum Change; in Hooper (ed.) (1971) The Curriculum: Context, Design & Development, pp. 375 – 398. Oliver & Boyd, Edinburgh in association with the Open University.

Huber, J. and Harkavy, I. (2007) (edits.), Higher Education & Democratic Culture, Paris: Council of Europe.

Illeris, K. (edit.)(2009), Contemporary Theories of Learning: Learning Theories…in their own words, London and New York: Rutledge.

ISESCO and UNESCO. (1999), Improving the Effectiveness of Curriculum Development and Reform in Africa, A handbook for curriculum planners.

Jackson, P. W. (1980), Curriculum and its discontents, Curriculum Inquiry, Vol. 10, No. 2 (summer, 1980), pp. 159-172.

Jacob, E. (1988), Clarifying Qualitative Research: A focus on Traditions, Educational Researcher, 1998, Vol. 17, No. 1, 16-24.

Jansen, J. & Christie, P. (eds.) (1999), Changing Curriculum: Studies on Outcomes-based Education, South Africa: Jut Co. Ltd.

Jenkins, A, et al. (2003), Reshaping Teaching in Higher Education: Linking Research with Teaching, London and New York: Rutledge.

Jenkins, D. (1976), Curriculum Evaluation, Milton Keynes: the Open University Press

Jessup G. (1991), Outcomes: NVQs and the Emerging Model of Education and Training, New York: RoutledgeFalmer.

Johnson, D. W., & John, R. T (1994), Learning together and alone: Cooperative and individualistic learning (4th ed.), Boston, MA: Allyn and Bacon.

Johnson, J. A., (2001), Principles of Effective Change: Curriculum Revision that Works, The Journal of Research for Educational Leaders, Volume 1, Number 1, Fall 2001, http://www.uiowa.edu

Karseth, B. (2006), **"**Curriculum Restructuring in Higher Education After the Bologna Process: A New Pedagogic?" A monograph of a paper presented at The Third Conference on Knowledge and Politics at the University of Bergen, May 18-20th, 2005. *Revista Española de Educación Comparada,* 12 (2006), 255-284

Kearney, C. (2011), Efforts to Increase Students' Interest in Pursuing Science, Technology, Engineering and Mathematics Studies and Careers, Belgium: European School net (EUN Partnership AISBL) European Schoolnet's Member Countries - 2011 Report.

Kelly, A. V. (2004), The Curriculum: Theory and Practice (5th ed.), London, Thousand Oaks and New Delhi, SAGE Publications.

Kerr. J. F. (1968), The Problem of Curriculum Reform: in Hopper, R. (1971), The Curriculum: Context, Design and Development, (pp. 178-200).

King, R., Marginson, S. & Naidoo, R. (eds.) (2011), Handbook on Globalization and Higher Education, UK: Edward Elgar Publishing Center.

Klein, M. F. (1992), A perspective on the Gap Between Curriculum Theory and Practice, Theory into Practice, Volume xxxi, Number 3, September 1992. Taylor & Francis.

Kliebard, H. M. (1976), Curriculum Past and Curriculum Present, Educational Leadership. Association for Supervision and Curriculum Development, 1976. http://www.ascd.org/ASCD/pdf/journals/ed_lead/el_197601_kliebard.pdf

Kliebard, H. M. (2004), The Struggle for the American Curriculum, 1893 – 1958, (3rd ed.), New York: RoutledgeFalmer.

Knoop, H (No Date), "Setting up Institutes of Technology at Ethiopian Universities". Information paper.

Koro-ljungberg, M. & Douglas, E.P. (2008), State of Qualitative Research in Engineering Education: Meta-Analysis of JEE Articles, 2005-2006, Journal of Engineering education, pp. 163-175, April 2008.

Kouwenhoven, W. (2009), Competence-based curriculum development in higher education: some African experiences.

Krathwohl, D. R. (2002), Theory into Practice, Volume 41, Number 4, Autumn 2002. Copy right © 2002 College of Education, The Ohio State University.

Krauss, S. E. (2005), Research Paradigms and Meaning Making: A Primer, The Qualitative Report Volume 10 Number 4 December 2005 758-770 http://www.nova.edu/ssss/QR/QR104/krauss.pdf University of Putra, Selangor, D.E., Malaysia.

Krefting, L. (1991), Rigor in Qualitative Research: The Assessment of Trustworthiness, The American Journal of Occupational Therapy, March 1991, Volume 45, Number 3.(pp. 214 -222)

Lahiff, A. (2009), Curricula Debate in Higher Education—an overview, University of Dublin, Trinity College.

Lathem. S. A., et.al. (2011), The Socially Responsible Engineer: Assessing Student Attitudes of Roles and Responsibilities, *Journal of Engineering Education,* July 2011, Vol. 100, No. 3, pp. 444–474, ASEE. http://www.jee.org.

Lattuca, L.R. & Stark, J.S. (2009), Shaping the College Curriculum: Academic Plans in Context (2nd ed.), JOSSEY-BASS: A Wiley Imprint, www.jossybass.com

Lattuca, R. et.al. (2006), The Changing Face of Engineering Education, The Bridge, Volume 36, Number 2, Summer 2006).

Learning Point Associates, (2009), Connecting Formative Assessment Research to Practice: An Introductory Guide for Educators.

Lefrançois, G. R. (2000), Theories of Human Learning: What the Old Man Said (4th ed.), USA: Wadsworth/Thomson Learning.

Lemlem, T. (2010), Review of Some Recent Literature: Identifying Factors that Affect Ethiopia's Education Crisis, *Ee-JRIF Vol 2, No 2 2010 - Education Issue: pp. 56-68*.

Leydens, J. A., Moskal, B. M. and Pavelich, M. J. (2004), Qualitative Methods Used in the Assessment of Engineering Education, Journal of Engineering Education, January 2004, pp. 65-72

Leydens. J. A. et.al. (1004), Qualitative Methods Used in the Assessment of Engineering Education, *Journal of Engineering Education*, January 2004 (pp. 65-72).

Longstreet, W.S. & Shane, H.G. (1993), Curriculum for a New Millennium, Boston: Allyn and Bacon.

Luiz, AG. et al (2004), The University-Industry Collaboration as a strategy for Engineering Education, In: Onwuka, E.N. (2009) Reshaping Engineering Education Curriculum to Accommodate the current Needs of Nigeria, Education Research and Review, Vol. 4(7), pp. 334-339, July, 2009. http://www.academicjournals.org/ERR

Lunenburg, F. C. (2011), Theorizing About Curriculum: Conceptions and Definitions. International Journal of scholarly Academic Intellectual Diversity, volume 13, Number 1, 2011.

Luxhøj, J.T. & Hansen. P.H.K. (1006), Engineering Curriculum Reform at Aalborg University *Journal of Engineering Education, (pp 183-186).* July 1996

Essomba, M. A., Karatzia-Stavlioti, E., Maitles, H. and Zalieskiene, I. (2008), Developing the conditions for Education for Citizenship in Higher Education.

Marsh, C. J. (2006), Key Concepts for Understanding Curriculum (3rd ed.), London and New York: RoutledgeFalmer.

Marshall, C. & Rossman, G. B. (1999), Designing Qualitative Research (3rd ed.), SAGE Publications.

Marton, F. and Booth, S. (1997), Learning and Awareness, New Jersey: Lawrence Erlbaum Associates, Inc., Publishers

Matthews, C. M. (2007), Science, Engineering, and Mathematics Education: Status and Issues, CRS Report for Congress, Updated April 23, 2007.

McCaslin, M. L. & Scott, K.W. (2003), The Five-Question Method for Framing A Qualitative Research Study: The Qualitative Report Volume 8 Number 3 September 2003 447-461. http://www.nova.edu/ssss/QR/Qr8-3/mccaslin.pdf

McGee, C. (1997), Teachers and Curriculum Decision-making, Palmerston North: Dunmore Press.

McKernan, J. (1993), Challenges to the Public School Curriculum: New Targets and Strategies, University of Limerick.

McKernnen, J. (2008), Curriculum and Imagination: Process Theory, Pedagogy and Action Research, London and New York: Rutledge.

McKimm, J. (2007). Curriculum Design and Development, A paper written as part of the Deanery's web-based learning package for clinical teachers

McMillan, J. H. & Schumacher, S. (1993), Research in Education: A conceptual understanding, New York: HarperCollins.

Mekasha, K (2005), Ensuring the Quality of Ethiopian Higher Education in the Face of the Challenges of the 21st Century, The Ethiopian Journal of Higher Education, Vol. 2, No. 2 December 2005, pp. 103-130.

Merriam, S.B. (1998), Qualitative Study and Case Study Applications in Education. San Francisco: Jossey-Bass Publishers.

Meyer, J. W. (1977), The Effects of Education as an Institution. *American Journal of Sociology* 83, 1: 55-77.

Meyer, J. W., Francisco, O., Richard, R., and John Boli-Bennett (1977), "The World Educational Revolution, 1950-1970." Sociology of Education 50:242-58.

Mills, J. E. & Treagust, D. F. (2003), "Engineering Education – Is Problem-based or Project-based Learning the Answer?" Australasian J. of Engng. Educ., online publication 2003-04 http://www.aaee.com.au/journal/2003/mills_treagust03.pdf: The Australasian Association for Engineering Education Inc. ISSN 1324-5821

Minister of Civil Service, (2011), Directives to Provide for Autonomy of the Institutes of Technology at Addis Ababa University, (AAU Board, Directive No. 1/2003). http://www.aau.edu.et/aait/academics/school-of-electrical-and-computer-engineering/overview-of-ece/.

Ministry of Information, (1960), Speeches Delivered by His Imperial Majesty Haile Sellaaie 1st Emperor of Ethiopia on Various Occasions, May 1957 – December 1959, Addis Ababa: Commercial Printing Press.

Misganaw S., (2002), "Instructors Participation in Curriculum Decision - Making Process in Ethiopian Teacher Education Colleges" unpublished Thesis Presented to the school of Graduate Studies, Addis Ababa University.

MoE (1950), Imperial Ethiopian Ministry of Education Year Book, Eth. Cal. 1944-45 (1951-53).

MOE and Fine Arts, (1953) (1946 E. C.), A Ten – Year Program for the Controlled Expansion of Ethiopian Education, The Third Report) Addis Ababa, unpublished

MoE and Fine Arts, (1954a) (1946 E. C.), A Ten – Year Program for the Controlled Expansion of Ethiopian Education, The First Report) Addis Ababa, unpublished.

MoE and Fine Arts, (1955b) (1947 E. C.), A Ten – Year Program for the Controlled Expansion of Ethiopian Education, The Third Report) Addis Ababa, unpublished.

MoE, (1950), Imperial Ethiopian Ministry of Education Year Book, Eth. Cal.1940-41 (1947-48).

MoE, (1950), Imperial Ethiopian Ministry of Education Year Book, Eth. Cal. 1942-43 (1949-51).

MoE, (1980), New Educational Objectives and Directives for Ethiopia, Addis Ababa unpublished.

MoE, (1984), Education in Socialist Ethiopia: Origins, Reorientation Strategy for Development, Addis Ababa.

MoE, (1984), The Ethiopian School Syllabus, Ministry of Education of Socialist Ethiopia, Curriculum Department, unpublished.

MoE, (2001), Indicators of the Ethiopian Education System, Addis Ababa.

MoE, (2002), Higher Education Capacity Building Program, Main Document esdp-2 2002/03-2004/05 plan Addis Ababa

MoE, (2002), The Education and Training Policy and Its Implementation (Introduction, pp. 1 – 3 also, p. 11), February, 2002.

MoE, (2005), Ethiopian Higher Education Sector Capacity Building Strategy for 1998-2002 E.E. (2005-2009), Addis Ababa.

MoE, (2008), “Annual Intake and Enrollment Growths and Professional and Program Mix of Ethiopian Public Higher Education: Strategy and Conversion Plan, 2001-2005” (edited version) Unpublished paper.

MoE, (2010), Education Sector Development Program IV (ESDP IV) 2010/2011 – 2014/2015 2003 EC – 2007 EC Program Action Plan, Addis Ababa.

MoE, (2010), Education Statistics Annual Abstract 2002 E. C. (2009-2010 G.C), Addis Ababa: EMIS, Planning and Resource Mobilization Management Process

MoFED, (2002), Ethiopia: Sustainable Development and Poverty Reduction Program, Ethiopia, July, 2002, Addis Ababa.

MoFED, (2006), Ethiopia: Building on Progress. A Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06-2009/10), Volume I: Main Text.

MoFED, (2007), Ethiopia: Building on Progress: A Plan for Accelerated and Sustained Development to End Poverty (PASDEP), Annual Progress Report 2006/07, December, 2007, Addis Ababa.

MoFED, (2008), “The Engineering Capacity Building Program” in Ethiopia, Summary Version of the Evaluation, Evaluation Reports 039, July 2008.

MoFED, (2010a), Growth and Transformation Plan 2010/11 – 2014/15, Volume II: Policy Matrix, Ministry of Finance and Economic Development, November 2010, Addis Ababa.

MoFED, (2010b), Growth and Transformation Plan 2010/11 – 2014/15, Volume I: Main Text, Ministry of Finance and Economic Development, November 2010, Addis Ababa.

Molnar, A (1992), Contemporary Curriculum Discourse: Too Much Ado about Too Much Nothing, Theory into Practice, Volume xxxi, Number 3, Summer 1992.

Morell, L. (2007), Engineering Education, Globalization and Economic Development: Capacity Building for Global Prosperity, International Engineering Education Journal, October, 2007.

Morgan, H. and Houghton, A. (2011), Inclusive curriculum design in higher education: Considerations for effective practice across and within subject areas, Commissioned by Higher Education Academy https://www.heacademy.ac.uk/sites/default/files/resources/Introduction%20and%20overview.pdf

Morrow, R. M. (1994), Issues Facing Engineering Education, *Journal of Engineering Education, pp. 15-18, January 1994*.

Mourtos, N.J. (2013), Defining, Teaching, and Assessing Engineering Design Skills: in Industrial Engineering: Concepts, methodologies, Tools and Applications, U.S.A: IGI Global, pp. 1-17.

NEA, (2010), Global Competence in a 21st Century Imperative, Education Policy and Practice Department | Center for Great Public Schools | 1201 16th St., NW, Washington, D.C. 20036, 2010 (PB28A),

Nguyen, Duyen Q. (1998), The Essential Skills and Attributes of an Engineer: A Comparative Study of Academics, Industry Personnel and Engineering Students. Global J. of Eng. Educ., Vol. 2, No.1, © 1998 UICEE, Printed in Australia

Noumi, I. C. (2007), Theories of the Causes of Higher Education Systems and Higher Education System Changes, International Center for Higher Education Research, University of Kassel.

Olds, B. M., Moskal, B. H. & Milles, Ronald L. (2005), Assessment in Engineering Education: Evolution, Approaches and Future Collaborations, Journal of Engineering Education, January, 2005 (pp. 13 – 25).

Oliver & S. L. & Hyun E. (2011), Comprehensive Curriculum Reform in Higher Education: Collaborative Engagement of Faculty and Administrators, Journal of Case Studies in Education 2 (2011): 1-20, University of Massachusetts Boston

Oliver, S. L. & Hyun, E. (no date), Comprehensive curriculum reform in higher education: Collaborative engagement of faculty and administrators, Journal of Case Studies in Education http://www.aabri.com/manuscripts/10649.pdf (Accessed on 30th of Dec. 2012)

Olorunfemi, A.I & Ashaolu, M.O. (No date), A Pragmatic Approach in Engineering Education Teaching Methods and Industry Partnership, Lagos: Lagos State Polytechnic. http://www.sefi.be/wp-content/abstracts/1261.pdf (accessed on 25/03/2012).

O'Neil, J. (1994), The Challenge of Outcome-Based Education, Educational Leadership March 1994 | Volume **51** | Number **6,** (pp. 6-10), Aiming for New Outcomes: The Promise and the Reality, Association for Supervision and Curriculum Development

Onwuka, E.N. (2009), Reshaping Engineering Education Curriculum to Accommodate the Current Needs of Nigeria, Educational Research and Review Vol. 4(7), pp. 334 – 339, July 2009.

Ornstein, A. C. & Hunkins, F. P (1988), Curriculum: Foundations, Principles and Issues, Englewood Cliffs, New Jersey: Prentice Hall

Ornstein, A. C. (1987), The High School Journal, Vol. 70, No. 4(Apr. – May, 1987), pp. 2008-216.

Ornstein, A.C., Behar-Horenstien & Pajk, E.F (2003), Contemporary Issues in Curriculum (3rd ed.), Boston & New York: Parson Education, Inc.

Pacheco, J. A. (2012), Curriculum Studies: What is The Field Today? Journal of the American Association for the Advancement of Curriculum Studies - Volume 8, 2012.

Page, R. N. (2009), Foreword. In E. C. Short & L. J. Waks (Eds.), Leaders in Curriculum Studies: Intellectual Self-Portraits (pp. ix-xvi) Rotterdam: Sense Publishers.

Parkay, F.W., (2006), Curriculum Planning: A Contemporary Approach (8th ed.). Boston & New York: Pearson Education. Inc.

Parsons, J & Beauchamp, L. (2012), From Knowledge to Action: Shaping the Future of Curriculum Development in Alberta, Canada: the Crown in Right of Alberta.

Patton, M.Q. (2002), Qualitative Research and Evaluation Methods (3rd ed.). Thousand Oaks, CA: Sage.

Payton, O. D. (1979), Research: The Validation of Clinical Practice. Philadelphia: F. A. Davis.

Pearlma, M. (2006), in: Dwyer, Carol A. et al. A Culture of Evidence: Postsecondary Assessment and Learning Outcomes. ETS,

Perry, R. P and Smart, J. C. (eds.) (2007), Scholarship of Teaching and Learning in Higher Education: Evidence Based Perspective, Netherlands: Springer.

Petrina, S (2004), Interchange, Vol. 35/1, 81-126, Netherlands: Kluwer Academic Publishers.

Petrina, S. (2007), (edt.), Advanced Teaching Methods for the Technology Classroom, Mershey, London, Melbourne, and Singapore: Idea Group Inc.

Piaget, J. (1950), The Psychology of intelligence, London and New York: Routledge & Kegan Paul.

Pike, G. R. & Kuh, G. D. (2005), A Typology of Student Engagement for American Colleges and Universities, Research in Higher Education, Vol. 46, No. 2, March 2005, (pp. 185 – 209).

Pinar, W. F (1978), The Reconceptualization of Curriculum Studies, In: Flinders, D. J. & Thornton, S. J. (2004), The Curriculum Reader (2nd ed.), New York and London.

Polczynski, M. (2009), The Impact of Technology and Globalization on the Engineering Profession and Education, Proceedings of the 2009 ASEE North Midwest Sectional Conference

Popham, W.J, & Baker, E.L. (1970), Systematic Instruction, Englewood Cliffs, NJ: Prentice-Hall.

Population and Housing Census of Ethiopia (2007), Statistical Report at Country Level, Addis Ababa.

Prados, J. W (no date), Engineering Education in the United States: Past, Present, and Future, the University of *Tennessee.*

Prados, J. W. (1998), Action Agenda for Systemic Engineering Education Reform: Next Steps, Realizing the New Paradigm for Engineering Education Proceedings, pp. 1-27

Pratt, D. (1980), Curriculum Design and Development, New York: Harcourt Brace.

Prince M. J. & Felder, R. M. (2006), Inductive Teaching and Learning Methods:

Prince M. J. & Felder, R. M. (2007), The many Faces of Inductive Teaching and Learning, National Science Teachers Association (NSTA). Reprinted with permission from *Journal of College Science Teaching*, Vol. 36, No. 5, March/April 2007.

Punch, K. F. (2005), Introduction to Social Research: Quantitative and Qualitative Approaches (2nd ed.), London, Thousand Oaks, and New Delhi: SAGE Publications.

Raburn, R. (1993), Outcome-Based Education: Some Questions Addressed, OASCD Journal 5 (May 1993).

Rayner, P. “quality and Ideological Construct”, in: the Proceedings of the Conference on the Future Direction of Higher Education in Ethiopia, pp. 109 – 130.

Reding, V. (2000), Two Decades of Reform in Higher Education in Europe: 1980 onwards (preface), Euryice Studies, The Information Network in Education in Europe

Report of the Education Sector Review, (1973). Education Challenge to the Nation. Part C., Technical Report.

Ritchie, J. & Lewis, J. (eds.) (2003), Qualitative Research Practice: A Guide for Social Science Studies, London, Thousand Oaks & New Delhi: SAGE Publications.

Ritz, J. M. (2009), A New Generation of Goals for Technology Education, Journal of Technology Education, Vol. 20 No. 2, (pp. 50-64) spring 2009.

Robertson, S. L. (2006), Globalization, GATS and Trading in Education Services, UK: Centre for Globalization, Education and Societies, University of Bristol.

Roffe, I. (2010).Sustainability of Curriculum Development for Enterprise Education, Education + Training, Vol. 52 Issue 2 pp. 140 – 164.

Rompelman, O. and Graaff, E. De (2006), The engineering of engineering education: curriculum development from a designer’s point of view, European Journal of Engineering Education, Vol. 31, No. 2, May 2006, 215–226

Rugarcia, A., Felder, R. M., Woods, D. R., and Stice, J. E. (2000), The Future of Engineering Education: A Vision for A New Century, *Chem. Engr. Education*, *34*(1), 16–25 (2000).

Saint, W. (2004), Higher Education in Ethiopia: The Vision and Its Challenges, JHEA/RESA Vol. 2, No. 3, 2004, pp.83–113, Boston College & Council for the Development of Social Science Research in Africa, 2004.

Sampson, H. (2004), Navigating the waves: the usefulness of a pilot in qualitative research, In: Qualitative Research vol. vol. 4(3): Copyright © 2004, 383-402, London, Thousand Oaks, CA and New Delhi: SAGE Publications.

Santiago, P. et.al. (2008), Tertiary Education for the Knowledge society – OECD Thematic Review of Tertiary Education, Volume 1, OECD

SAQA (South African Qualification Authority) (2000), The National Qualifications Framework and Curriculum Development, http://www.saqa.org.za

Schofer, E. and Meyer, J. W (2005), The Worldwide Expansion of Higher Education in the Twentieth Century, American Sociological Review, Vol. 70, No. 6 (Dec., 2005), pp. 898-920, American Sociological Association, http://www.jstor.org/stable/4145399, Accessed: 07/01/2010

Schwab, J. J. (1964), Structure of the disciplines: Meanings and Significances, in Golby, M. et.al. (eds.) (1975) Curriculum Design (pp. 249 – 267) The Open University Press.

Schwab, J. J. (1969), The Practical: A language for Curriculum, in Flinders, D. J. & Thornton, S. J. (2004) The Curriculum Reader (2^{nd} ed.) pp. (103 – 117) New York and London

Schwab, J. J. (1978), The Practical: A language for curriculum. In J. Westbury & N. J Wilkof (eds), Science, curriculum and liberal education (pp. 287 – 321) Chicago: University of Chicago Press.

Schwab, K. (2010), The Global Competitiveness Report 2010–2011, Geneva: The World Economic Forum.

Schwartz, S. (2003), The Higher Purpose,

Schwarz, G. & Cavener, L. A. (1994), Outcome-Based Education and curriculum Change: Advocacy, Practice and Critique, Journal of Curriculum and Supervision 9, no. 4 (1994): 326-338

Shim, J. M. (2009), Violent Turbulence in Curriculum Theory and Practice, Journal of Curriculum Theorizing ♦ Volume 25, Number 1, 2009.

Slattery, P. (2006), Curriculum Development in the Postmodern Era (2^{nd} ed.) New York and London: Rutledge.

Smerdon, E.T (2000), An Action Agenda for Engineering Curriculum Innovation, A paper presented at the 11th IEEE-USA Biennial Careers Conference, November 2-3, 2000, San Jose, California .

Smith, M. K. (1996, 2000), Curriculum theory and practice the encyclopedia of informal education, www.infed.org/biblio/b-curric.htm.

Society of Professional Engineers (NSPE) (2013), Engineering Body of Knowledge, Prepared by the Licensure and Qualifications for Practice Committee of the National Society of Professional Engineers

Solomon A. (2010), Tension Between Massification and Intensification Reforms and Implications for Teaching and Learning in Ethiopian Public Universities, JHEA/RESA Vol. 8, No. 2, 2010, pp. 93–115, Council for the Development of Social Science Research in Africa 2010 (ISSN 0851–7762)

Solomon, A. (2008), Policy Formulation, Curriculum Development and Implementation in Ethiopia. Addis Ababa University Book Center.

Spady, W. G. & Marshall, K. J. (1991), integrating the Curriculum: Beyond the Traditional Outcome-Based Education, Educational Leadership, pp. 67-71, Association of supervision and Curriculum Development.

Spady, W.G. (1988), organizing for results: The basis of authentic restructuring and reform, Educational Leadership, October: 4-8, 1988.

Spencer, D. B. and Mehler, G. (2013), Opportunities in Engineering Education: Pathways to Better-Prepared Students, The BRIDGE, , National Academy of Engineering, Vol. 43, No. 2, Summer 2013 (pp. 24 – 30).

Spink, A & Mal, Jens-Eric (2013), Developing People's Information Capacities: Fostering Information Literacy in Educational Workplace & Community Contexts, UK: Emerald Group Publishing Limited.

Splitt, F. G. (2002), Environmentally Smart Engineering Education: A Brief on a Paradigm in Progress. Journal of Engineering Education, October, 2002 (pp. 447 – 450).

Splitt, F. G. (2003), The Challenge to Change: On Realizing the New Paradigm for Engineering Education. Journal of Engineering Education, April 2003.

Srivastava, A. & Thomson, S.B. (2009).Framework Analysis: A Qualitative Methodology for Applied Policy Research. JOAAG, Vol. 4. No. 2, pp. 72-79

Sryyedrezaie, S.H. (2013), Constructivism and Curriculum Development: International Journal of Sciences & Applied Research, Vol. 2(1), 62-67, 2013.

Stake, R. E. (2005), Qualitative Case Studies, In: Denzen, N.K. & Lincoln (eds.) (2005) The Sage Handbook of Qualitative Research (3rd. ed.) (pp. 443 – 466), Thousand Oaks, CA: sage

Stake, R.E. (1994), Case Studies. In: N.K. Denzin and Y.S. Lincoln (eds.), Handbook of Qualitative Research. London: SAGE Publications. pp. 236- 247.

Streveler, R. A. & Smith, K. A. (2006), Conducting Rigorous Research in Engineering Education, Journal of Engineering Education April 2006 (pp. 103 – 105).

Tadmor, Z. (2006), Redefining Engineering Disciplines for the Twenty-First Century, The Bridge, Vol. 36, No. 2, Summer 2006, (pp. 33-37) National Academy of Engineering.

Taba, H. (1962), Curriculum Development, New York, Chicago: Harcourt Brace. Jovanovich, Inc.

Taber, K.S. (2011), Constructivism as Educational Theory: Contingency in Learning, and Optimally Guided Instruction, In: Educational Theory, Jaleh, H. (ed.), (2011) pp. 39-61.

Talib1, F. et.al. (2010), The relationship between total quality management and quality performance in the service industry: a theoretical model. International Journal of Business, Management and Social Sciences Vol. 1, No. 1, 2010, pp. 113-128

Tanner, D & Tanner, T.N (1980), Curriculum Development: Theory into Practice. New York: Macmillan Publishing Co., Inc.

Tavner, A. (2005), Outcomes-Based Education in a University Setting, Australasian J. of Engng. Educ., Online Publication 2005-02, http://www.aaee.com.au/journal/2005/tavner05.pdf.

Taylor, P. (2001). 10 key stages towards effective participatory curriculum development, Zurich: Helvetas, Swiss Association for International Cooperation.

Teichler, U. (2004), "Changing Structures of the Higher Education Systems: The Increasing Complexity of Underlying Forces" Papers produced for the UNESCO

Forum Regional Scientific Committee for Europe and North America, Paris, March 2004 (ED-2006/WS/44).

Tekeste, N (2006), Education in Ethiopia: From Crisis to the Brink of Collapse, Sweden: Elanders Gotab AB, Stockholm.

Teklehaimanot, H. (1999). The Cultural Foundation of Education in Ethiopia, IER Flambeau, 7(1), 1-10.

Temechegn E, (2000), "What Research says About African Science Education" IER FLAMBEAU, Volume 8, Number 1, December 2000.

Terwel, J. (1999), Constructivism and its Implications for Curriculum Theory and Practice, J. Curriculum Studies, 1999, vol. 31, no. 2, 195 – 199, 0022 - 0272/99 , Ñ 1999 Taylor &Francis Ltd.

Terwel, J. (1999), Constructivism and its implications for Curriculum Theory and Practice, J. Curriculum Studies, 1999, Vol. 31, No. 2, 195 – 199.

Tesfaye T. & Kassahun K. (2009), Quality Assurance for Enhancement of Higher Education in Ethiopia: challenges faced and lessons learned,

Teshome, G. Wagaw (1979) Education in Ethiopia: Prospect and Retrospect, Ann Arbor: The University of Michigan Press.

Teshome, Y. (2005), Ethiopian Higher Education Sector Capacity Building Strategy for 1998-2002 E.C. (2005-2009), Ministry of Education, Addis Ababa.

Teshome, Y. (2007), The Ethiopian Higher Education: Creating Space for Reform, St. Mary's UC Printing Press.

Tessmer, M. & Richey, R. C. (1997), The Role of Context in Learning and Instructional Design, ETR&D, Vol. 45, No. 2, 1997, pp. 85-115, ISSN 1042-1629.

Tierney, W. (1995), Cultural Politics and the Curriculum in Postsecondary Education; In J. Haworth & C Conrad (eds.). Revisioning Curriculum in Higher Education. Needham Heights, MA: Simon and Schuster.

Toombs, W. and Tierney, W. (1991), Meeting the Mandate: Renewing the College and Departmental Curriculum. ASHE-ERIC Higher Education Report No. 6, 1991, http://files.eric.ed.gov/fulltext/ED345603.pdf.

Trevelyan, J (2010), Mind the Gaps: Engineering Education and Practice, Proceedings of the 2010 AaeE Conference, Sydney.

Trotskovsky, E. Sabag N. (2014), Internship Project - Design in Industry vs. Research in Academia – A case study. Journal of International Scientific Publications Educational Alternatives ISSN 1314-7277, Volume 12, 2014, www.scientific-publications.net

Trudeau, (1964) Higher Education in Ethiopia, Montrial, A doctoral project

Tyler, R. (1969), Educational Evaluation, New Roles, New Means. The Sixty – eights Year Book of Education. Chicago: University of Chicago Press.

Tyler, R. W. (1949), Basic Principles of Curriculum and Instruction, Chicago and London: The University of Chicago Press.

UNESC, (2006), Bridging the Technology gap Between and within Nations, Report of the Secretary General, Commission on Science and Technology for Development, Ninth session Geneva, 15–19 May 2006

UNESCO Expert Group, (1995), Strategic Issues in Engineering Education in Africa, Report of the Expert Group Meeting on Engineering Education in Africa, Nairobi, Kenya.

UNESCO, (1998a), The World Declaration on Higher Education for the Twenty-First Century: Vision and Action, adopted by World Conference in 1998, http://www.unesco.org/education/educprog/wche/declaration_eng.htm.

UNESCO, (1998b), Higher Education in the Twenty-first Century Vision and Action, UNESCO, Paris, 5–9 October 1998

UNESCO, (2010), Engineering: Issues, Challenges and Opportunities for Development, France: United Nations Educational, Scientific and Cultural Organization.

United Nations University, (2009), Revitalizing Higher Education in Sub-Saharan Africa, a United Nations University Project. www.unu.edu/africa

Varghese, N. V. (2008), Contribution of higher education and research to education for all (EFA), paper commissioned for the EFA Global Monitoring Report 2009, Overcoming Inequality: why governance matters".

Vrasidas, C. (2000), Constructivism versus objectivism: Implications for interaction, course design, and evaluation in distance education. International Journal of Educational Telecommunications, 6(4), 339-362.

Vygotsky, I. (1978), Mind in Society: The Development of Higher Psychological Processes, Cambridge, MA: Harvard University Press.

Wang, V. C. X. and King, K. P. (2009), Building Workforce Competencies in Career and Technical Education. A Volume in Adult Education Topics: Theory, and Practice in Lifelong Learning, U.S.A.: Information Age Publishing.

Wankat, P. C. and Oreovicz (1993), Teaching engineering, McGraw-Hill,

Wiedmaier-Pfister, M., Dagnew, G., Wolday A., Mommartz, R., Duflos, E., and Steel, W. (2008), Access to finance in Ethiopia, Sector assessment study, Volume 2, for the German Technical Cooperation within the Engineering Capacity Building Project

Wilczynski, V. and Douglas, S. M. (1995), Integrating Design across the Engineering Curriculum: A Report from the Trenches, *Journal of Engineering Education*, pp. 235-240

Wiles, J. & Bondi, J. (1989), Curriculum Development: A guide to Practice (3rd ed.), New York: Merill, an imprint of Macmillan Publishing Company.

Wondwessen, K (2006), in AAU Faculty of Technology Curriculum Reform, Introduction, Book one, “Forward”

Woollacott, L. (2007) A Rationale for a Universal Document Based on the CDIO Syllabus and the Taxonomy of Engineering Competencies, Proceedings of the 3rd International CDIO Conference, MIT, Cambridge, Massachusetts, June 11-14, 2007 Johannesburg University of the Witwatersrand.

World Bank (2010), Financing Higher Education in Africa, Washington, D.C.: The International Bank for Reconstruction and Development.

World Bank, (2000), Higher Education in Developing Countries: Peril and Promise, Washington, D.C.: The International Bank for Reconstruction and Development / THE WORLD BANK.

World Bank, (2007), Higher Education Quality Assurance in Sub-Saharan Africa: Status, Challenges, Opportunities and Promising Practices, Washington D.C.: World Bank.

Woube K. (2000), The Need for Analyzing Culture in Planning Curriculum, IER FLAMBEAU, Volume 11, Number 2, June 2004.

Wray, M. (2013), Developing an inclusive culture in higher education: final report. York: Higher Education Academy.

Wuhibegezer F. (2013), Historical evolution and the dynamics of modern education in Ethiopia, Journal of Educational Research and Studies Vol.1 (5), pp. 40-49, October, 2013, ISSN: 2329-3039, Peak Journals

Wulf, W.A. (1998), The Urgency of Engineering Education Reform, In: Realizing the New Paradigm for Engineering Education, Proceedings, June 3-6, 1998, pp. 28-30.

Wulf, W.A. (1998): In Realizing the New Paradigm for Engineering Education: Proceedings, January 3-6, 1998, pp 28-30. New York: Engineering Foundation Conferences, Three Park Avenue.

Yin, R. K. (1999) Enhancing the Quality of Case Studies in Health Services Research, HSR: Health Services Research 34:5 Part II (December 1999).

Yin, R. K. (2003), Case Study Research (3rd ed.), Thousand Oaks, London and New York: SAGE Publications

Yuan, R. (2004), The Globalization of Science and Engineering Studies. Advance proof, copyright 2004 COSMOS JOURNAL.

Appendices

Appendix A—Consent Form

Interview Protocol for the Research entitled "Curriculum Development Process of the New Engineering Education Program in Ethiopia"

Consent Form

University/Institute: ___________________________________

Name of Interviewee: ____________________ Title: _______________ Date: ________

Department: ______________________ Years of Service: ______ Phone: ___________

Interviewed By: ____

This interview is designed to solicit information about the process and practice of the engineering curriculum development, practices and its constituents, how it is perceived within the higher education institutions including information about the nature, characteristics, opportunities and challenges in its implementation. The goal is to locate, illuminate, and understand the distinctive values, specific practices, and skills which lend the engineering curriculum development validity. In other words I am interested in understanding more about what is happening when we are at our best.

The information you provide in this interview will be used only for the purpose of the research identified above and by no means jeopardize your private personality as a result of breaking confidentiality. My interest is in learning from your experience. The collected comments, experience and suggestions from you and others will be summarized, coded, and analyzed to full-fill the intention of improving the engineering Curriculum Development process.

Thank you in advance for your willingness to be interviewed

Mesfin Sileshi

PhD candidate

I have read the consent form and recognize that my participation in this study is entirely voluntary and that I am free to withdraw at any time during the course of the study without consequence. I understand that my information resulting from this study will be strictly confidential. I realize that I may ask for further information about this study if I wish to do so at any time.

I have received a copy of this consent form for my own records. I agree to participate in this study.

____________________________ Date _____________________

Participant’s Signature

Appendix B—Sample Interview questions

No.	Research Question	Strategies for data collection	Sample of Leading questions for the interview & the focus group discussion
1.	Why was the engineering curriculum reform initiated? How was it developed?	Interview Document analysis	What were the main reasons that led to the reform of engineering education and curriculum? Who was involved in the curriculum development? How was your role and involvement in the curriculum development?
2.	How do deans, teachers and students view and describe engineering curriculum and the congruency between the curriculum expectations and its implementation?	Document analysis Interview Focus group	How do you characterize/perceive the new engineering curriculum? What were your expectations in terms of the teaching/learning process, assessment, outputs? And why? How does your role as a teacher influence the curriculum development process and its practices in the field of studies you are teaching? Do you think the assessment of student's performance of the knowledge and skills/competencies is done effectively? If so, How? If not, why?
3.	What are the factors that influenced engineering curriculum development and its practices?	Interview Focus group Documents	What do you think is very important in engineering education for a student to be successful? And how do you make it happen as a teacher? How do you characterize the teaching learning process and the assessment mechanism in the field of study you are teaching? Why?
4.	How do employers assess their involvement in curriculum design process and in its relevance? What are their expectations of the new engineering graduates in terms of their knowledge, skills, and competencies?	Interview Documents	Have you or any member of your company, in the past, involved in making suggestions on engineering education and/or curriculum development? Please elaborate. How do you characterize engineering graduates who are newly employed in your company with regard to their knowledge and skills/competencies? Please elaborate. What is your idea of engineering education and curriculum provided within the educational institutions and how can your industry contribute in this regard?

Appendix C—Permission to ASTU

አዲስ አበባ ዩኒቨርሲቲ
ሥነ ትምህርት ኮሌጅ
የሥርዓተ ትምህርት መምህራን
ሙያ ልማት ትምህርት ክፍል

Addis Ababa University
College of Education
Department of Curriculum
And Teacher Professional
Development Studies

☎ 239716 ✉ 1176 Fax: 00251(11) 242719 e-mail:

Date 26 Oct 2011

To: Whom It May Concern

Ato Mesfin Sileshi is a PhD student at Addis Ababa University. He/she is working on a research project entitled.
Curriculum Development Process, Perceptions Of Stakeholders on Engineering.

I would be most grateful if you extend to him/her all the necessary assistance regarding this Matter.

Thank you for your kindness

Sincerely

GebreEgziabher Debeb
Chairperson, Department of Curriculum and
Teachers Professional Development Studies

TO Engineering School
p/s assist him

Tolla Berisso Geda (Dr.)
Academic Vice President
17/01/13

TO. Civil Eng. Dep't
Electrical Eng.
Mechanical Eng.
Please show your kind support

Appendix D—Permission to AAiT

Appendix D—Permission to AAiT

አዲስ አበባ ዩኒቨርሲቲ
ሥነ ትምህርትና ሥነ ባህሪ ጥናት ኮሌጅ
የሥርዓተ ትምህርት መምህራን ሙያ
ልማት ትምህርት ክፍል

Addis Ababa University
College of Education and Behavioral Studies
Department of Curriculum & Teacher Professional Development Studies

☎ 239716 P.O 1176 Fax: 00251(1) 239716 e-mail: tecs.aau@telecom.net.et

Date February 8, 2015

To: Whom It may concern

Mesfin Sileshi is a PhD student at Addis Ababa University. He/She is working on a research project entitled.
Curriculum Development Process and Practices of the New Engineering Education Program in Ethiopia

I would be most grateful if you extend to him/her all the necessary assistance regarding this Matter

Thank you for your kindness

Sincerely

Getachew Adugna, (PhD)
Chair, Department of Curriculum and Teachers Professional Development Studies

TO 1.
2.
3. (Asso. SECE)

please assist Mr. Mesfin in his research work by facilitating those whom he wants to interview

242

Appendix E—Permission to BiT

አዲስ አበባ ዩኒቨርሲቲ
ሥነ ትምህርትና ጠባይ ጥናት ኮሌጅ
የሥርዓተ ትምህርት መምህራን ሙያ
ልማት ትምህርት ክፍል

Addis Ababa University
College of Education and Behavioral Studies
Department of Curriculum & Teacher Professional Development Studies

☎ 239716 *✉ 1176* *Fax: 00251(1) 239716* *e-mail: tecs.aau@telecom.net.et*

Date February 8, 2013

To: Whom It May Concern

Mesfin Sileshi is a PhD student at Addis Ababa University. He/She is working on a research project entitled.
Curriculum Development Process and Practices Of the New Engineering Education Program in Ethiopia.

I would be most grateful if you extend to him/her all the necessary assistance regarding this Matter.

Thank you for your kindness.

Sincerely

Getachew Adugna, (PhD)
Chair, Department of Curriculum and Teachers
Professional Development Studies

To: School of
1. Civil and Water Reso
2. Mechanical and Ind
3. Electrical and Comp
for your corpora
7689
765720
918765360 Solomon T.

243

Appendix F—Permission to Industry

ኤሌክትሪክ ኃይል ኮርፖሬሽን
ETHIOPIAN ELECTRIC POWER CORPORATION
ውስጣዊ ማስታወሻ

INTERNAL MEMORANDUM

ቁጥር፡ ሰ.ኃ.ሥ/175/2005

ቀን፡ ሚያዚያ 09 ቀን 2005 ዓ.ም.

ለ፡ ጀነሬሽን ኮንስትራክሽን አስተዳደርና ፋይናንስ ቢሮ

ለ፡ ትራንስሚሽን ሰብስቴሽን ኮንስትራክሽን አስተዳደርና ፋይናንስ ቢሮ

ለ፡ ለአገር አቀፍ ኤሌክትሪክ አቅርቦት ፕሮግራም አስተዳደርና ቢሮ

ከ፡ ሰው ኃይል ሥልጠናና ልማት ቢሮ

ጉዳዩ፡- ለዩኒቨርስቲ ተማሪ ለምርምር የሚረዳ መረጃ ትብብርን በተመለከተ፣

የአዲስ አበባ ዩኒቨርስቲ የPHD ተማሪ የሆኑት አቶ መስፍን ስለሺ Curriculum Development process and practices of the new Engineering Education in Ethiopia በሚል ርዕስ ለሚያደርጉት ጥናት የሚያስፈልጋቸውን መረጃ እንዲሰጣቸው የአዲስ አበባ ዩንቨርስቲ ስኑ-ትምህርትና ጠባይ ጥናት ኮሌጅ የሥርዓተ ትምህርት መምህራን ሙያ ልማት ትምህርት ክፍል ጠይቋል፡፡ ስለሆነም በእናንተ በኩል የሚፈልጉትን መረጃ ማግኘት እንዲችሉ አስፈላጊው ትብብር እንዲደረግላቸው እንጠይቃለን፡፡

የሰው ኃይል ሥልጠናና ልማት ቢሮ
Tel 011-6463317 011-6463316 ጠይም 011-6463470 Ex 209,211& 214
D:\ Memo 2005

Appendix G—Example of Signed Consent

Appendix G—Example of Signed Consent

ADDIS ABABA UNIVERSITY
DEPARTMENT OF CURRICULUM AND
TEACHER PROFESSIONAL DEVELOPMENT

INTERVIEW PROTOCOL FOR THE RESEARCH ENTITLED

"CURRICULUM DEVELOPMENT PROCESS AND PRACTICES OF THE NEW ENGINEERING EDUCATION PROGRAM IN ETHIOPIA"

Consent Form

Name Dr ... *Title* Asst. Prof. *Date* 01/03/2013
Group/ Department ______ *Years of Service* ______ *Phone* ______
Interviewed by Mesfin Sileshi

This interview protocol is designed to solicit information about the process and practice of the engineering curriculum development, practices and its constituents, how it is perceived within the higher education institutions including information about the nature, characteristics, and challenges in its implementation. The goal is to locate, illuminate, and understand the distinctive values, specific practices, and skills which lend the engineering curriculum development validity. In other words I am interested in understanding more about what is happening when we are at our best.

The information you provide in this interview will be used only for the purpose of the research identified above and by no means jeopardize your private personality as a result of breaking confidentiality. My interest is in learning from your experience. The collected comments, experience and suggestions from you and others will be summarized, coded, and analyzed to full-fill the intention of improving the Engineering curriculum development process.

Thank you in advance for your willingness to be interviewed

Mesfin Sileshi

PhD candidate

I have read the consent form and recognize that my participation in this study is entirely voluntary and that I am free to withdraw at any time during the course of the study without consequence. I understand that any information resulting from this study will be strictly confidential. I realize that I may ask for further information about this study if I wish to do so at any time.

I have received a co... consent form for my own records. I agree to participate in this study.

01/03/2013
Date

Assistant Professor (Dr.-Ing.)

245

THE CURRICULUM DEVELOPMENT PROCESS OF THE NEW ENGINEERING EDUCATION PROGRAM AND ITS PRACTICES IN ETHIOPIA: The Case of Three Higher Engineering Education Institutions

By

Mesfin Sileshi

A Thesis Submitted to the Graduate Studies of Addis Ababa University in fulfillment of the requirements for the Degree of Doctor of Philosophy in Curriculum Design and Development

Addis Ababa University,
Addis Ababa, Ethiopia
January, 2016

THE CURRICULUM DEVELOPMENT PROCESS OF THE NEW ENGINEERING EDUCATION PROGRAM AND ITS PRACTICES IN ETHIOPIA: The Case of Three Higher Engineering Education Institutions

By

Mesfin Sileshi

Advisor
Dawit Mekonnen (PhD)

A Thesis Submitted to the Graduate Studies of Addis Ababa University in fulfillment of the requirements for the Degree of Doctor of Philosophy in Curriculum Design and Development

Addis Ababa University,
Addis Ababa, Ethiopia
January, 2016

Addis Ababa University

College of Education and Behavioral Studies

Department of Curriculum and Teachers' Professional Development Studies

This is to certify that the thesis prepared by Mesfin Sileshi entitled: The Curriculum Development Process of the New Engineering Education Program in Ethiopia: The Case of Three Higher Engineering Education Institutions

and submitted in partial fulfillment of the requirements for the degree of **Doctor of Philosophy in Curriculum Design and Development** complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

Signed by the Examining Board Committee:

Dawit Mekonnen	[signature]	19/01/2016
Supervisor	Signature	Date
ABEBE DINKU	[signature]	19/1/2016
Internal Examiner	Signature	Date
JM CASE	[signature]	19/1/2016
External Examiner	Signature	Date
Gebregziabher Desta	[signature]	
Chair person	Signature	Date

Dedicated to: Amen Mesfin

Abstract

The overall aim of this dissertation is to contribute to the improvement of the engineering curriculum development and engineering students' learning in Ethiopia by utilizing both theoretical and empirical enquiry. The study tried to provide insights into the major processes and factors that influence engineering curriculum development and its implementation process in general and investigates the impact of the curriculum development and implementation process on the quality of engineering education and students' learning, from the perspectives of stake holders. The study is undertaken within three engineering higher education institutions. The research tried to provide answers for the following four research questions. (1) Why was the engineering curriculum change initiated? And how was it developed? (2) How do deans, teachers and students view and describe engineering curriculum and the congruency between engineering curriculum implementation and curriculum expectations? (3) What are the factors that influenced engineering curriculum development? (4) How do stakeholders assess their involvement in engineering curriculum design process and in its relevance? What are their present understanding of the new engineering graduates in terms of their possession of engineering knowledge, skills and competencies? A qualitative multiple-case study design was employed to undertake the study. Primary data were collected from purposely selected engineering teachers, students, industry personnel, and experts from the MoE using in-depth interview and focus group discussion methods. Document analysis was also used as a source for secondary data. The data collected from the different sources were analyzed using an inductive thematic analysis method based on inductive category development procedure. The findings of the study revealed that the reform in engineering education and its curriculum development was driven by economic interest, which was expressed in terms of producing skilled human resource that would work in industry and boost its productivity. The idea of the reform and the curriculum development process was a top-down process initiated by the ECBP under the leadership of MoCB. Teachers' participation in the curriculum development process was initially one of learning from the ECBP and organizing it in the curriculum; not in decision making. Industry's involvement in engineering curriculum matters was found to be occasional and not in a way it puts significant impact on curricular decisions. Curriculum implementation which involves teaching, learning, and assessment, was knotted with multiple problems of: poor dissemination of the ideas of the reformed curricula, dissatisfied teaching staff and teachers absenteeism, teaching and learning crippled with shortage of resources, shallow students' learning, and pseudo assessment mechanism. Based on the findings of the study, a number of recommendations are forwarded to improve engineering curriculum development and students' learning which include the need for more participation of stakeholders in the process of curriculum development, the necessity of creating more awareness and understanding of the changes in curriculum within the engineering teaching staff, the need for more and continuous training of engineering teachers to update and improve their teaching and assessment skills abreast their engineering profession. The need for the development of educational policies that support the alignment of engineering teaching with assessment, and finally areas for further theoretical research and empirical enquiry are also suggested to support the improvement of the engineering teaching and learning development within the engineering and technology institutions in Ethiopia.

Key words: Engineering curriculum, curriculum development, engineering teaching, qualitative research.

Acknowledgements

I would like to express my gratitude to a number of people who in one way or the other helped me to complete this dissertation work. First, I acknowledge my academic advisor, Dr. Dawit Mekonnen for the unreserved, meticulous comments, suggestions and advice he provided me throughout the progress of this work. I have been very fortunate to have his unyielding support, continuous positive reassurance and his professional guidance. His meticulous and tireless consultations have been pivotal during the whole period of this work.

My thanks also goes to the staff of Addis Ababa University for their unreserved academic and administrative support they have provided me during my course work and during the time of writing this dissertation.

I am also indebted to the engineering deans, teachers and students of Adama Science and Technology University, Addis Ababa Institute of Technology, and Baher Dar Institute of Technology who have participated in this research and provided me their invaluable insights about their experiences in curriculum development and their experiences in the actual practices of teaching and learning at the classroom and/or workshop level.

My gratitude also goes to Dr. Wana Leka and Dr. Jeylan Aman for their reading the material and providing me with feedback that contributed to the work. My thanks also goes to the industry leaders who permitted me to undertake the interview for this research within their respective companies and to the personnel who participated in the interview and provided me the valuable information and insights that contributed significantly to this study.

I am also grateful to my brother, Getahun Sileshi, his wife, Haimanot, and my nephew, Kidist Aklilu and Ato Solomon Shiferaw for the psychological and material support they have provided me during my endeavor of this work. Finally, I am very grateful for my wife, Algayenesh Afework for her devotion and moral support she has provided me during the entire process of this study. I am also grateful to my daughter, Amen Mesfin; her patience and enduring love have been the source of my inspiration in this journey.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

AAiT	Addis Ababa Institute of Technology
AAU	Addis Ababa University
AAUC	Addis Ababa University College
ABET	Accreditation Board for Engineering and Technology
ACQUIN	Accreditation, Certification and Quality Assurance Institute
ASEE	American Society for Engineering Education
ASTU	Adama Science and Technology University
AU	Adama University
B.Sc	Bachelor of Science
BIT	Bahir Dar Institute of Technology
CA	Constructive Alignment
CDIO	Conceive-Design-Implement-Operate
CE	Civil Engineering
DA	Dublin Accord
E.C	Ethiopian Calendar
ECBP	Engineering Capacity Building Program
ECTS	European Credit Transfer System
EE	Electrical Engineering
EEA	Ethiopian Economic Association
EELPA	Ethiopian Electric Power and Light Authority
EiABC	Architecture, Building Construction and City Development
ESDP	Education Sector Development Plans
ETA	Ethiopian Telecommunications Authority
ETP	Ethiopian Education and Training Policy
FDRE	Federal Democratic Republic of Ethiopia
FG 1	Focus Group One
FG 2	Focus Group Two
FG 3	Focus Group Three

FoT	Faculty of Technology
FTI	Further Training Institute
GATS	General Agreement on Trade in Services
GTP	Growth and Transformation Plan
HELENA	Higher Education Leading to Engineering and Scientific Careers
HEP	Higher Education Proclamation
HERQA	Higher Education Relevance and Quality Agency
HESC	Higher Education Strategic Center
HESO	Higher Education System Overhaul
ICDE	Institute of Continuing and Distance Education
Ind.	Industry
IoTs	Institutes of Technology
LCD	Liquid Crystal Display
M.A	Master of Arts
ME	Mechanical Engineering
MI	Ministry of Information
MoCB	Ministry of Capacity Building
MoE	Ministry of Education
MoFED	Ministry of Finance and Economic Development
N	Number (Referring to participants in the study)
n.d	No date
NCTTE	Nazareth College of Technical Teacher Education
NSPE	National Society of Professional Engineers
NTC	Nazareth Technical College
OBE	Outcome Based Education
OCCB	Office for the Coordination of Capacity Building
PSCAP	Public Sector Capacity Building Program
RESR	Report of the Education Sector Review
S&T	Science and Technology
SA	Sydney Accord
SAQA	South African Qualification Authority

SHS	Social and Humanity Sciences
SoA	School of Agriculture
SoB	School of Business
SoE	School of Engineering
SoH	School of Health and Hospital
SoHN	School of Humanities and Natural Sciences,
SoP	School of Pedagogy and Vocational Teacher Education
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISA	University of South Africa
USA	United States of America
WA	Washington Accord

CHAPTER ONE

INTRODUCTION

1.1. Introduction

This chapter includes background of the study, statement of the problem, the research objectives, the research questions, scope of the study, limitations of the study, significance of the study, and the theoretical framework.

1.2. Background of the Study

Education helps in shaping the present as well as the future in terms of developing individuals' knowledge, skill and attitudes, and in the promotion of important and useful ideas within a society. Formal education in any country is hierarchically structured, sequentially ordered and higher education occupies the top position within such educational hierarchy (Varghese, 2008). Higher education, as a part of an education system of any country is entrusted to contribute to the future and to play a vital role in the countries' intellectual, economic, cultural and social development.

Higher education, in general, is believed to be an important means through which students learn and develop democratic values, skills and principles (Dewey, 1929; Essomba, Karatzia-Stavlioti, Maitles and Zalieskiene, 2008). The university, as an institution is also regarded as an "agent" and "servant" of democracy (Huber & Harkavy, 2007: 42). According to Huber & Harkavy, the university is an agent because it's continuing activities nurture "deliberation" and the democratic spirit. It is the servant because its members- faculty, staff, students, and alumni dedicate their professional skills to serve the wider common goal. The university is also understood as a "democratic public sphere" (Giroux, 2015: 110) in which education enables students to develop a keen sense of prophetic justice, claim their moral and political agency, utilize critical analytical skills, and an ethical sensibility through which they learn to respect the rights of others.

Higher educated citizens are more likely to understand democracy in terms of free elections, civil rights, gender equality, and economic prosperity (Chzhen, 2013).

In recent years, higher education is emphasized to be one of the powerful forces for individual growth, societal progress and cultural and economical development (Bloom, Canning, & Chan, 2005; MoE, 2010). Higher education is seen more than ever, as a focal point for the socio-economic and political development of nations (UNESO, 1998; Schwab, 2010, World Bank, 2007; Santiago, et.al., 2008).

In another sense, higher education is also regarded as one of "the 12 pillars of competitiveness" (Schwab, 2010: 4) that drive productivity. Schwab states that quality higher education and training is crucial for economies that want to move up the value chain beyond simple production processes and products. As pointed out in UNESCO (1998a: 1):

> *Without adequate higher education and research institutions providing a critical mass of skilled and educated people, no country can ensure genuine endogenous and sustainable development and, in particular, developing countries and least developed countries cannot reduce the gap separating them from the industrially developed ones. Sharing knowledge, international co-operation and new technologies can offer new opportunities to reduce this gap* (1998a: 1).

This quotation, in the first place, informs us that higher education and research institutions are significantly important for sustainable development. In the second place, it tells us that genuine and endogenous development would be difficult without cooperation and sharing of knowledge. In the third place, it also informs us that technology is one of the indispensables in the endeavors of development. A similar idea was also promoted by the World Bank (2000). The findings of the Commission on Science and Technology for Development (CSTD) as reported by the secretary general (2006), also pointed out that "most developing countries are unlikely to narrow the technology gap without making Science and Technology top priorities in their development agenda" (CSTD, 2006: 17).

Research has also suggested that there is a strong association between higher education participation rates and levels of development, and that high levels of education are essential for the design and production of new technologies, for a country's innovative capacity and for the development of civil society (Cloete, Bailey & Maassen, 2011). Hence, society holds high expectations of people in professions entrusted with the well-being of people and society as a whole (Davis & Davis, 2005). Higher education institutions, in general, are required to educate and train personalities who would be able not only to think individually and creatively but also to successfully act and compete individually or in groups in both national and foreign labor market. Hence, education reformers in the late 1980s and in the 1990s argued that society needed and called for a workforce which is flexible, highly qualified, independent and entrepreneurial work (Bleiklie, 2004).

Curriculum in higher education is understood as one of the key concepts by which the idea of higher education is put into practice (Barnett, 2009; Barnett & Coate, 2005: 5). At college level, curriculum is regarded as an "academic plan" that implies a deliberate planning process that focuses attention on important educational considerations (Lattuca & Stark, 2009: 4) which will vary by field of study, instructors, students, and institutional goals. Curriculum informs what the purpose of education should be, what to include in this education, how and when to do it and how to check the effectiveness and think of further improvement in the whole process of education. Any curriculum development process strives for answering the question of how a curriculum is planned, implemented and evaluated, as well as what people, processes and procedures are involved (Ornstein and Hunkins, 2009: 15; McKernan 2008: 4).

UNESCO indicates that "most of the broader history of civilization, of economic and social relations, is the history of engineering, engineering applications and innovation" (UNESCO, 2010: 30). According to UNESCO, the Stone Age, Bronze Age, Iron Age, Steam Age and Information Age all relate to engineering and innovation that shaped human beings' interaction with the world. In addition to its developmental roles, the engineering profession at the present time is also expected to address the large-scale pressing challenges facing societies worldwide. Gordon (1984) defines a professional engineer as "one who has attained and continuously enhances technical, communications, and human relations knowledge, skills, and attitudes, and who contributes effectively to society by theorizing, conceiving, developing, and producing reliable structures and machines of practical and economic value" (Gordon, 1984): in Crawley, et al. 2007: 11). Concern about engineering education, at undergraduate level and the curriculum development process and its practices then refers to laying down the ground for the preparation of the underlying requirements which means for developing and equipping individual learners to be able to know, understand and act effectively in engineering thinking, design and the production of improved artifacts and modern services through the use of science and mathematics to make the human life easier and comfortable. Engineering education as part of higher education and the curriculum development process associated with it and its practices at different levels occupy one of the central positions as a means of fulfilling of such expectations (Maraghy, 2011: 11, UNESCO Expert Group, 1995:1).

Engineering education is one of the central elements used to produce human resources for the social and economic development of any society (Bloom, Canning, and Chan 2006; UNESCO, 2010). Engineering education programs provide students with the knowledge, understanding, skills and competences required to be professional engineers. These include scientific and mathematical theory, engineering applications, design, problem-solving skills, and communication skills. The National Society of Professional Engineers (NSPE) (2013) refers to the knowledge, skills, and attitudes of engineers as "capabilities", where capability is defined as "what an individual is expected to know and be able to do by the time of entry into professional practice in a responsible role (NSPE, 2013:4). As pointed out by Duderstad (2008), the requirements of 21st-century engineering are considerable: engineers must be technically competent, globally sophisticated, culturally aware, innovative and entrepreneurial, and nimble, flexible, and mobile. In another tone, Rugarcia, Felder, Woods, and Stice (2000) also sketch engineers' profile in terms of three components, that is, in terms of:

> *(1) their knowledge—the facts they know and concepts they understand; (2) the skills they use in managing and applying their knowledge, such as computation, experimentation, analysis, synthesis/design, evaluation, communication, leadership, and teamwork; (3) the attitudes that dictate the goals toward which their skills and knowledge will be directed—personal values, concerns, preferences and biases. Knowledge is the data base of a professional engineer; skills are the tools used to manipulate the knowledge in order to meet a goal dictated or strongly influenced by the attitudes* (Rugarcia, et al, 2000: 20).

Some of the challenges to be addressed by engineering, among many others, include availing access to affordable health care, tackling the issues of energy, transportation, and climate change, providing equitable access to information, clean drinking water, natural and man-made disaster mitigation, environmental protection and natural resource management (UNESCO, 2010). To this end Maraghy (2011) states that "engineers play a key role in our societal development, contributing to and enabling initiatives that drive economic progress, enhance social and physical infrastructures, and inspire the changes that improve our quality of life" (Maraghy, 2011: 11). Moreover, Morrow asserts that engineering education as "the quintessential education required for nations to prosper in this technologically interdependent world in which we live" (Morrow, 1994: 15).

While engineering education and its importance is a widely recognized part of education that contributes to the overall development of individuals and society, it is pointed out that it is also caught up 'between seemingly irreconcilable tensions of two positions' (Crawley, Malmqvist, Ostlund & Brodeur, 2007: 10). According to Crawley et al., the tensions include: on one hand, the need to convey the ever-increasing body of technical knowledge that graduating engineers should master and on the other hand, the growing acknowledgement that engineers must possess a wide array of personal and interpersonal skills as well as the product, process and system building knowledge and skills required to function on real engineering teams to produce real products and systems (Crawley, et al. 2007: 10). These authors make clear that engineering educators "strike a balance that emphasizes the importance of technical knowledge" and on the other hand, industry representatives are concerned about the need for a broader view that give "greater emphasis to the personal and interpersonal skills, and product, process, and system building skills" (Crawley, et al. 2007: 10).

Research shows that engineering curriculum in the US before the 1940s at most colleges and universities was mostly practical with the emphasis on engineering design rather than on engineering sciences and mathematical applications (Lattuca, Terenzini, Volkwein, and Peterson, 2006; Splitt, 2003). Tryggvason and Apelian (2006) also indicate the past engineering education as it was focused on "hands-on training". However, after World

War II, the field of engineering and the undergraduate programs changed dramatically and the “launching of Sputnik in 1957 accelerated this shift, and by the early 1960s most of the old hands-on courses had been replaced by lectures” (Brent & Felder, 2003: 234).

Courses in advanced mathematics and theory replaced practical courses in machining, surveying, and drawing (Prados et al., 2005). But by the 1980s, such education left engineering employers to be dissatisfied (Lattuca et al., 2006; Gordon, 1984; Ambrose, 2013). Graduates from such programs were technically well prepared but lacked the professional skills for success in a competitive, innovative, global marketplace (Lattuca, et al. 2006). Employers complained saying that graduates of the programs had poor communication and teamwork skills and did not appreciate the social and nontechnical influences on engineering solutions and quality processes (McMasters, 2004; Todd et al., 1993). Then, a call for change and improvement of engineering education was signaled through several national reports within the USA (Lattuca et al, 2006) which eventually paved the way to the emergence of an accreditation set of criteria known as “Engineering Criteria 2000”. Such change in engineering education, however, requires the deliberation and use of curriculum which is designed, developed and implemented in accordance with the best of its peculiar nature and characteristics. In connection with this, nations all over the world, including the developed nations such as USA and many countries in Europe and elsewhere continually reexamine and re-energize their engineering curricula (Heywood, 2005; ASEE, 2010; Nguyen, 1998; HELENA, 2009; Felder, 2004). Haywood (2005:4) indicates that “understanding of the curriculum process requires an understanding of institutional structures, practices and procedures”.

A significant example of an engineering curriculum development model which is developed on the basis of the analysis of the issues and tensions prevalent in engineering education and with the consideration of the desired attributes of engineers is known as Conceive-Design-Implement and Operate (CDIO) (Crawley, et al., 2007). The CDIO program, as pointed out by Crawley and others, was developed based on critical need to educate students who are able to Conceive-Design-Implement-Operate complex, value-added engineering products, processes and systems in a modern, team–based environment (Crawley et al. 2007: 1). More or less similar actions were also taken in

Europe. The CDIO model was also recognized and implemented in some of European universities such as that of the University of Liverpool, (Kearney, 2011).

In Ethiopia, a system wide education reform in the wider public was heralded with the issuance of the Education and Training Policy in 1994 by the Federal Democratic Republic Government of Ethiopia (FDRE). In this document education in general is envisioned as bringing-up citizens endowed with human outlook, countrywide responsibility and democratic values having developed the necessary productive, creative and appreciative capacity in order to participate fruitfully in development and the utilization of resources and the environment at large (FDRE: 6). The document also pointed out that problems associated with relevance, quality, accessibility and equity need to be addressed and education should be future oriented. Moreover, it is also stressed that the aim of education has to do much with the idea of strengthening the "individuals' and society's problem-solving capacity, ability and culture all the way through basic education and at all levels" (FDRE, 1994: 1).

These being the essence upon which the present Ethiopian education policy in general rests, included in it were suggestions about the emphasis to be put on all levels of higher education and the type of graduates expected from higher education (FDRE, 1994: 15). It also suggested about the mechanism of implementing the curriculum in higher education and the qualification of teachers who would teach at that level (FDRE, 1994: 21). According to the same document, institutions are provided with autonomy of internal administration in designing and implementing education and training programs with an overall coordination and democratic leadership by boards or committees, consisting of members from the community (society), development and research institutions, teachers and students (FDRE, 1994: 30). It also pointed out how the curriculum should be prepared, implemented, and evaluated and that it has to be based on the stated education objectives. It has also outlined that the process of curriculum development: has to involve all the beneficiaries including professionals from major organization of development, has to be considerate of pedagogical and psychological methods and has to be up to international standard and there will be an integrated educational research, and overall periodic evaluation of the education system.

The issuance and implementation of the 1994 Education policy, undoubtedly resulted in a number of positive changes such as availing education for more people, the increase of educational institutions, provision of education in local language and the development of curricula in different language, and more, within relatively short time (MoFED, 2006:7-9).

A specific and more attention was given to higher education with the issuance of the Higher Education Proclamation (HEP) (Proclamation No. 351/2003) (FDRE, 2003)[1], by the government. This legal document emphasized the necessity of laying down the requirements that would enable the higher education system to produce quality skilled human power to meet the needs of the country, the necessity of directing research in higher education towards problem-solving and towards the utilization of potential resources, the necessity of the provision of academic freedom and accountability of higher education institutions and the administration within them and the necessity of determining the directions of private higher education institutions in order to promote their contribution in expanding education and conducting research. The objectives of higher education, as stated in this legal document included the following:

- *Produce skilled manpower in quantity and quality that will serve the country in different professions;*
- *Provide equitable distribution of higher education institutions;*
- *Lay down problem-solving educational and institutional system that enables to utilize potential resources of the country and undertake study and research;*
- *Provide higher education and social services that are compatible with the needs and development of the country.* (HEP, No. 351/2003: Article 6).

Within the same document it was also suggested that the curriculum in higher education has to focus on practical experience and student participation and that implementation should be practice-oriented; that it should take the objective situation of the country into consideration, encourage independent thinking, and reflect modern views, and that it has to be problem-solving. It also included suggestions about assessment of students (Article

32). As per this article, any institution should have an assessment mechanism to evaluate the ability and level of knowledge of the student and that assessment shall be based on the content of course or training offered to the student, and that the method of evaluation shall be determined by the institution.

However, after ten years of the issuance of the education policy and after one year enforcement of the Higher Education Proclamation (Proclamation 351/2003), the report of the Higher Education System Overhaul (HESO, 2004) declared that higher education institutions lacked a culture that puts stakeholders at the center of the quality process, that students did not have rights with respect to fair and open systems for establishing standards, that employer feedback is not collected systematically, and there is too little attention to the quality of educational outcomes.

Based on what it thought to be drawbacks and pitfalls of such as those mentioned herein above, the HESO report concluded that "Ethiopia does not yet have an elite university, i.e., a university that neither meets international standards nor do HEIs meet the development needs of the country in terms of relevance" (HESO, 2004). Nevertheless, the HESO committee recommended (among many other recommendations) an improved governance, leadership, and management that would contribute to desirable social outcomes of more graduates at every level, a better match of graduate knowledge and ability to Ethiopia's development needs, research and consultancy more relevant to the needs of the community, teaching, learning, research and consultancy that reach (or approach) international standards, responsible citizens and more equal society, and higher education instructors that support democracy and the constitution (HESO, 2004). The HESO inquiry focused more on the governance, leadership and matters associated with it. However, It "did not invest much in curriculum revision and/or development practices nor did it include specific reforms needed to overhaul the academic programs" (Solomon, 2010: 95).

---

[1] This document is replaced later, in the year 2009, by Higher Education Proclamation No. 650/2009.

In September 2009 the six year old Higher Education Proclamation No. 351/2003 was substituted with a new Higher Education Proclamation No. 650/2009 which served as a foundation for the reform of the higher education system. In this proclamation more emphasis was placed on the necessity of institutional transformation, the necessity of focusing on issues of relevance and equity of education and research, including ensuring good governance and others. Effecting institutional transformation and enabling the institutions to be dynamic centers of capacity building were also emphasized. In most respects the objectives stated in this proclamation are the same as those of the objectives, stated in proclamation 351/2003, but in proclamation 650/2009 additional emphasis was given on institutional expansion and access on the basis of need and equity. In addition to this, the Government's Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06-2009/10) which was issued in 2006 considered higher education as a significant means of meeting the need for highly trained work force.

Engineering education, which is part of higher education in the Ethiopian context, is provided within government and non-government universities, institutes, and colleges. There is no accrediting body specifically meant for engineering education in the Ethiopian context. The only external accrediting body concerned with matters related to higher education quality so far is the Higher Education Relevance and Quality Agency (HERQA). Even though, in principle, certain autonomy is delegated to the various government and educational institutions within the education system, the overall practice of education has to be consistent with the government's education policy and has to be guided by it, and this applies to engineering education as well in many respects. Anything that affects the whole system of higher education also affects the engineering education.

A more specific reform initiative geared to engineering education was the move taken by the Engineering Capacity Building Program (ECBP), which was launched in the year 2005 under the leadership of the Ministry of Capacity Building (MoCB) (Waidmaier-Pfister, et.al, 2008) and with financial and technical cooperation of Germany (Ethio-German, Negotiation, 2005) through the regulation of ECBP, carrying the motto "Building Ethiopia".

The government's agenda in launching the Engineering Capacity Building Program can be seen as part of the Public Sector Capacity Building Program (PSCAP) (FDRE, Proclamation No. 256/2001) and as part of the overall reform of higher education and training and capacity building that was aimed "at creating country wide sustainable human resource capacity that is responsive to changing circumstances" (MoE, 2002: 3). However, the reform in engineering education was more of responding to the need of industry which was fueled by the government's idea of "accelerating industrial development in Ethiopia" (Knoop, n.d). The main aim was to support the private sectors through supporting the institutions that support them, among which the university program was taken as one, (in fact, as pillar No. IV of the ECBP). The university reform component of ECBP was then intended to support the transformation of higher education, which in this case means engineering education, to deliver most needed human capital for the labor market. The objectives with regard to this were stated as the following:

- *Development and governance of efficient institutes that work at the intersection between higher education and economy*
- *Implementation of engineering study programs based on international standards;*
- *Integration of technology transfer approach to provide solutions to industry.* *(Knoop, n. d.)*

Generally, it is believed that higher education institutions are 'slow to change' and 'change is often forced on them from outside' (Haywood, 2005: 4). This seems true in the case of the Ethiopian engineering education. Unlike the usual practices of the curriculum development process in higher education in Ethiopia, and irrespective of the provisions stipulated in the policy documents, a curriculum framework was developed under the leadership and guidance of the ECBP, which received the support of German/Swiss experts. Based on that framework and supported by the aforementioned experts 'numerous new engineering courses' and 'occupational standards' were developed (Federal Ministry for Economic Cooperation and Development, 2008).

Even though there are a number of higher education institutions concerned with the provision of engineering education within the country, the Faculty of Technology of Addis Ababa University was regarded as the "change model" (Wondwossen, 2006) and was given priority to revise the then existing engineering curricula under close leadership and support of the ECBP together with those professors from Germany and from some other countries. As pointed out by the group of the German/Swiss experts who participated in the engineering curriculum development process, the general aims of the revised curricula were:

- *Orientation towards the expected qualification of the students at the end of their study time.*
- *Introduction of new teaching learning methods, especially interdisciplinary project work.*
- *Defining closer links between practice and theory as a continuous of needs and ideas between the academic and professional spheres. The curricula include different elements of practical training and internship in order to bridge the gap between industry and academia.*
- *The new curricula focus on specific Ethiopian issues in teaching and research which are significant for the future and sustainable development of the country.*
- *The curricula are based on a close, interdisciplinary cooperation between the respective departments. Exchange programs with national and international universities and institutions will be intensified.*
- *Providing effective tools for permanent sustainable quality assurance of study programs and didactic quality*
- *Restructuring of the Faculty of Technology;* (Bayou, Tenagne, Bühler, and Oswald, 2006: 7).

After the curriculum development process was over at the faculty level and as soon as the preliminary peer review process was undertaken by a peer group of the Accreditation, Certification and Quality Assurance Institute (ACQUIN) in Germany, implementation (at least in pilot form) was began in the academic year 2006/2007 in government engineering faculties/institutes notably at the Faculty of Technology of Addis Ababa University (now divided in to two institutes of technology-AAiT and EiABC). Implementation of curricula also continued in other similar engineering institutions and universities, such as those selected for this study, in subsequent years.

1.3. Statement of the Problem

It has been mentioned earlier in this chapter that echoes of change in the Ethiopian education system were signaled more than ever since 1994 with the issuance of the education policy and the subsequent education proclamations and guidelines provided by the Ethiopian government. The ideas of change, on one hand was to lay the ground that addresses problems of various natures such as those related to quality of education (Bayou, et al. 2006) and to alleviate the shortage of skilled and semi-skilled human labor (EEA, 2008) within the prevailing system, on the other hand it was an attempt of widening the scope of the system to accommodate new opportunities and ideas and at the same time to reach to the wider populace within the nation. The former of these ideas can be seen as an idea of improving and transforming the existing system and to give it better shape and form for better use. On the other hand, the latter calls for creating a totally new ground for practice that requires the preparation and availing of both physical and human resources that can be used for materializing the new ides. While the former idea is to improve the existing system by changing some of its aspects, the later demands a fresh idea and practice of introducing new educational elements which require availing new infrastructure like school buildings, new equipments, and knowledgeable human resources for its implementation.

So, the current Ethiopia as a nation, in its attempt of changing the education system, is caught up between those contesting challenges of improving the existing system and expanding the system with the intention of addressing new challenges and problems. The problem in this research then arises from this context. As far as this researcher is concerned there is no evidence of publically known and a comprehensively documented reform attempt in the wider context of engineering education in Ethiopia until the launching of the Engineering Capacity Building Program (ECBP) in 2005 which adopted a guiding motto of “Building Ethiopia” in its reform effort (Bayou, Tenagne, and Bühler, 2006). Nevertheless, the few available sources reveal that there were some changes associated with the durations allotted for the provision of engineering programs within the educational institutions and these were made usually in connection with the regime changes of the country (Demiss, Alem, Daniel, and Edessa, 2006). Furthermore, one of the scanty available materials also points out that:

> *The education in the FoT was not sufficiently practice oriented, graduates were not problem solvers, its administration and governance system is plagued with undue centralization, insufficiency and lack of transparency. Furthermore, the Faculty’s weak link to the industry has led to inability to make curriculum and research relevant to the needs of the country and, therefore, has resulted in its limited contribution to the national economy* (RSC, 2007: 6).

The Ethiopian government, fueled with an ambitious program of accelerating industrial development through supporting the engineering program, launched the reform in engineering education in 2005 under the leadership of the MoCB through a specific program identified as Engineering Capacity Building Program (ECBP) in cooperation with Germany (Ethio-German Negotiations, 2005). The ECBP by then has four components, of which, one is the university reform component that was particularly geared to the reforming of engineering education. The ECBP was based on the guiding principles of "private sector, market and demand orientation, improved qualifications of human resources, entrepreneurship development and public-private-Dialogue (PPP) to make individuals and enterprises competitive in the international market" (Bayou et al (2006: 15) and its objectives include the:

- *Development and governance of efficient institutes that work at the intersection between higher education and economy*
- *Implementation of engineering study programs based on international standards;*
- *Integration of technology transfer approach to provide solutions to industry.*

Based on these principles, through the support and guidance of the ECBP, a number of curricula were developed and implemented since 2006/2007 Academic Year within different engineering education institutions. Moreover, the Ethiopian Government has placed high emphasis on the provision of science and engineering education (MoE, 2008) to those students who qualify and join higher education. As per this priority, 70% of those who qualify for entrance to higher education are streamed to science and engineering education. While 40% of these are further assigned to the different fields of engineering education, the rest 60% are dispersed across the natural sciences, mathematics and other educational streams.

According to the Government's Growth and Transformation Plan I. by 2014/15 the total number of students who join higher education at the undergraduate level will be 467445 (MoFED, 2010a: 20). Out of these, about 327211 of them will be placed in science and engineering education from which 40% are again streamed to engineering education. This, according to the provision in the "Annual Intake and Enrollment Growths and Professional and Program Mix of Ethiopian Public Higher Education" (2008), means that by the year 2014/15, the number of students who will be admitted to engineering education will be 130884. This number is about 28% or more than one quarter of the total number of students (467445) who join higher education.

Generally seen, the objective of the ECBP was to improve the framework for economic and private sector development through demand-oriented engineering, technical and vocational education reform, and quality infrastructure upgrading and business improvement throughout the country. It is now about seven years since the implementation of the reformed curricula took place in the Ethiopian engineering education institutions. Many engineering students have already graduated using the reformed curricula and many others are in the pipe line. A number of graduate engineers have already started joining the world of work within the country. This implies that the reformed system generally has started to give the desired results, at least in terms of the number of engineers that are needed in the country. The key question is, however, is it only the increase in the number of engineers that matters to the country? If not, what else should be considered? Obviously, the answer to the last question points towards the quality of engineers in terms of their knowledge, skill, attitude and what they can do in the real world of work upon their graduation. This is why the current study intended to look into the process of the curriculum development and the actual practices that are taking place on the ground, where the interface between the ideas of the curriculum and the people who put it into effect and between the people who are affected by it taking place, within the identified three institutions from the perspective of the stakeholders.

Although studies of curriculum and curriculum development process in engineering education are very much limited in the Ethiopian context, experiences of the curriculum development process in general, and its practices at all levels of education in Ethiopia have never been without criticisms all the way through the history of the Ethiopian modern education system. Problems associated with curriculum and curriculum development are rooted in many ways in the Ethiopian education system at each level of education, irrespective of the fields of studies and/or the subjects to be taught/learned and the skills, competencies, attitudes to be developed. Discontents of such type were reflected in the works of many writers and researchers who have dealt with issues related to curriculum development and its practices at various levels along the continuum of the education system in Ethiopia since the 1950s. For example, MoE (1950) has stipulated that there was lack of uniformity of subject matter taught in equivalent grades or levels of instruction. MoE, (2002) has also identified and summarized the problems and the various challenges pertaining to the education system at all levels. Shibabaw (2002) indicated that teachers lack curriculum knowledge, Temechegn (2000) on his part has pointed out that there are varying problems associated with science education, furthermore, (Amare 1998 and Woube 2004) have identified that there is lack of cultural considerations in curriculum development. More recently, Mulu (2009) mentioned that the curriculum in higher education follows traditional methods and focuses on theory and lacking the practical side. His findings have also revealed that the teaching learning method is teacher-focused rather than student centered, Ayalew, Dawit, Tesfaye and Yalew (2009) pointed that staff in Hawassa and Baher Dar Universities do not meet the minimum standards set by the Ministry of Education, that the university entrants are not prepared for higher education, that the contents of the curricula do not match the graduate profile indicated in the programs, and that learning resources do not adequately match the size of enrollments in the respective areas of studies and where the materials and equipment are available in some quantity, there are not enough technically qualified personnel to maintain, repair and properly use them, Solomon (2010) revealed that the environment in most public universities is "messy and the quality of teaching and learning are at risk" and he pointed out that excessive government intervention and lack of autonomy are the prime factors contributing to this risk.

In fact, the problems addressed in those studies appear to have existed within the other levels of education as well and most of them do not rest particularly within the scope of this study, yet, their implication to engineering education is evident since engineering students are the products of the curriculum and its practices at those levels. The problems can be characterized as multi-dimensional and interrelated to each other. Yet, the specific nature and depth of the problems in curriculum development and practices at all levels specifically at the level of higher education including engineering education, are not well known and are less researched in the context of the Ethiopian education system. Curriculum development is an iterative process that swings between the intent of education system and its actual practices. This means that the study of curriculum, without giving due consideration to the actual practices on the ground, remains to be the study of a document (curriculum document) which is devoid of the process of teaching and learning and the people involved in the process. The scarcity or the unavailability of research on curriculum development process and its practices in comprehensive form, almost at all levels of the education system that includes higher education including engineering education may obscure the reality with which the engineering curriculum is functioning on the ground. Such a situation does not lend itself to making advancement on what is good and to making corrections on what sounds unclear and irrelevant in terms of both epistemological perceptions and practical aspects. Hence, the researcher claims that the nearly non-existence of research similar to this in engineering education in general, and in engineering curriculum development and its practices in particular, in the Ethiopian context, together with the points made herein below, makes this study the first of its kind and, hence, essential, in terms of its contributions both epistemologically and practically. Moreover, the strengths and weaknesses of the engineering curriculum development process that has been implemented since the year 2006/2007 Academic Year has not yet been comprehensively researched and evaluated, at least to the knowledge of this researcher. Thus, it is hoped that this research, to some extent, also contributes to identifying the strengths and the challenges of the engineering curriculum development process and its practices within the context of the Ethiopian education system.

1.4. The Research Objectives

The research has the following objectives:

- To understand the core ideas that informed/guided the reformed engineering curriculum development process and to analyze them from the perspectives of the participants;
- To find out and understand the consistency of the present engineering curriculum practices and its implementation with the perspectives of stakeholders;
- To determine what the participants consider as major influences of curriculum development process in engineering education in the Ethiopian context;

- To identify the challenges and opportunities that may prevail in the process of the engineering curriculum development and its practices.

1.5. The Research Questions

2. Why was the engineering curriculum reform initiated? How was it developed?
3. How do deans, teachers and students view and describe engineering curriculum and the congruency between the curriculum expectations and its implementation?
4. What are the factors that influenced engineering curriculum development?
5. How do employers assess their involvement in curriculum design process and in its relevance? What are their expectations of the new engineering graduates in terms of their knowledge, skills, and competencies?

1.6. Scope of the Study

The study is bounded in time, location of the study, participants of the study, and the programs of study. In terms of time, it covers the engineering curriculum development process and practice staring from 2005 to the time this research was conducted. In terms of the number of institutions it covers three engineering higher education institutions, that is, one School of Technology within a university setting and two Institutions of Technology (IoTs) selected from among the ten institutions available in the country. In terms of participants, the study is delimited to those purposely selected deans, teachers, and students of institutes/schools, and few representatives from industry and MoE because they are regarded as having better knowledge of the subject and are assumed to be affected by the program directly or indirectly. In terms of the programs of study (fields of studies), the research is bounded to teachers and students of the long existed fields of studies, that is, Civil Engineering (CE), Mechanical Engineering (ME), and Electrical Engineering (EE) within the three sites of the study.

1.7. Limitations of the Study

The qualitative case study method used in this study is believed to be more appropriate in investigating and explaining the problem identified by the researcher and to answer the research questions raised. One of the limitations in this study is the limited use of local research and other materials on engineering education and curriculum development due to its unavailability. Hence, the researcher was forced to rely more on materials of outside origin. Secondly, though this researcher is aware of the use of modern technologies such as NVivo, ATLAS.ti, HyperRESEARCH, and the like, for qualitative data organization and data analysis, the effort made to get access to and make use of such software was not successful because of its unavailability.

1.8. Significance of the Study

Currently, provision in engineering education is the highest priority in the Ethiopian higher education system due to the government's policy. Based on this policy and other accompanying guides, many of the students joining higher education enroll to the fields of engineering. Since 2006/2007 academic year, new and reformed curricula have been introduced within the engineering institutions and a number of students who have been educated with these curricula have already graduated and the rest are in the pipeline. This is a clear sign that the policy is heading positively towards meeting the goal at least in availing the number of engineers needed.

However, past experiences, in the context of Ethiopia, do not show that there is rich experience of research in engineering education in general and particularly in curriculum development. Hence this researcher believes that the results of this study can contribute significantly to the body of knowledge and empirical findings as related to engineering education and curriculum development process and its practices in the Ethiopian context, particularly in the three sites of the study. The citations included throughout the material and the rich review of the related literature in Chapter Two can provide the different perspectives and orientations upon which engineering education curriculum development rests. The research will also benefit engineering teachers and students by way of acquainting them with the recent information related to the knowledge, skill, and attitude that are useful and required of the present and the future engineers and to focus their activities of curriculum development, teaching and learning, and assessment within their respective fields of studies along current and new line. It, in addition will be important for policy makers and planners to be more cognizant of the essential or the required components of the present and the future engineering education and to consider the appropriate and indispensable inputs during their policy making and planning. Since industry is the consumer of the final products of engineering education, it will also be one of the beneficiaries by way of being informed what is being practiced within the engineering institutions, in terms of teaching learning and how its implication affects the engineering profession.

1.9. Theoretical Framework and its description

Theories and concepts of education, curriculum, curriculum development and student learning in general, and the literature on engineering education related to curriculum development in particular provide the theoretical bases for understanding the nature of curriculum in general and the curriculum development process in engineering education in particular. Crew, Wickson, & Radcliffe (2006) indicate that:

> *Engineering education research is a transdisciplinary endeavor in both a literal sense (in that it draws on knowledge from the disciplines of engineering and education), and in a formal theoretical sense, given that transdisciplinarity is defined as problem solving through 'the context specific negotiation of knowledge'* (Carew, Wickson & Radcliffe, 2006: 1).

Curriculum development process in this study is seen as a process that strives for answering the question of how a curriculum is planned, implemented and evaluated, as well as what people, processes and procedures are involved (Ornstein & Hunkins 2009: 15). Based on the review of related literature of different nature, that is, on the concept of curriculum, curriculum development process and its practices, learning theories in general, and on the curriculum development process and practices of engineering education in particular, the researcher has dealt with the following theoretical considerations to serve him as the base for understanding what is known about the area on which the research focuses.

For a better understanding of the concept, nature and assumptions underlying the study of the curriculum development process and its practices in engineering education, and the factors that may affect its processes and practices are pointed out in the schematic representation which is depicted herein under; and which includes a brief description of each of the specific areas included in the framework are also briefly highlighted.

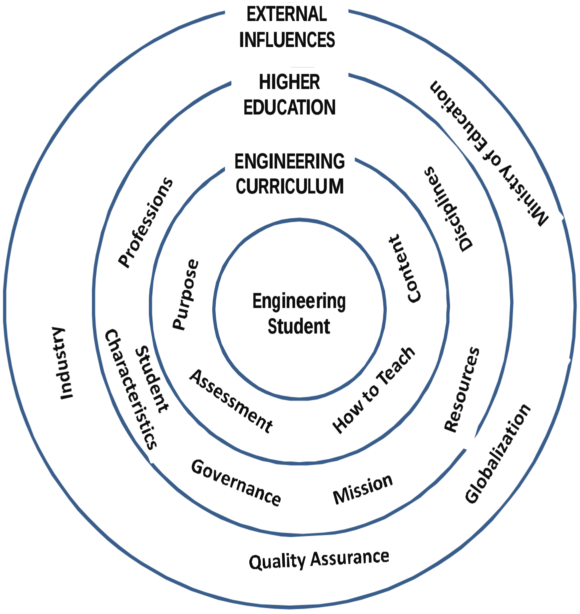


Figure 1. Engineering Curriculum Development Process Conceptual Framework

The framework shows that the engineering student is at the center of the curriculum development process and its practices. Everything that is manifested in any curriculum should be connected with and has to point towards students' learning and should contribute directly or indirectly to its success (Ratecliff, 1977; Fraser & Bosanquest, 2006). The second inner circle shows the generally accepted components of the curriculum, which mainly structure the curriculum used to shape the engineering student (Felder, Rugarcia & Stice, 2000). The "purpose" which, in the context of this study, refers to why engineering education is provided, and the "content" which, refers to the materials and practices which are intended to enable the student to be knowledgeable and skillful and do whatever he/she wants to do, the “how to teach” which refers to the mechanism by which the materials and practices are made available to the student and the communication that takes place within the classroom situation which is actually the method of teaching, and the “assessment” refers to the mechanism by which the overall achievement in the process of curriculum development and its practices is gauged -all these refer to the engineering student and the outcomes their after (Haywood, 2005; Knowles, 1973; Felder & Silverman, 1988; wankat & Oreovicz, 1993; Felder, Rugarcia & Stice; 2000, Felder & Henriques, 1995; Berthiaume, 2003; Marton & Booth, 1977; Ornstein & Hunkins 2009; Beyer & Apple, 1998; Biggs, 2003; Morgan & Houghton, 2011; Felder, 2012; Wray, 2013).

The third circle (from the middle) shows that the curriculum development process and the practices of engineering education, in many ways, cannot be free from the influences that affect the curriculum development process and its practices in higher education and what happens in higher education in general. This means the curriculum development process of engineering education and its practice is, somehow, influenced and embedded within the overall curriculum development process and practice of higher education and is influenced by what happens in it (Lattuca and Stark, 2009; Crawley, et al. 2008; Pister, 1993) This is true in the case of Ethiopian engineering education and probably similar elsewhere. For instance, the engineering profession and engineering education, in general, make the use of materials from other “disciplines” such as mathematics and other sciences. Moreover, engineers live and work with people, make business and make communications with people and the total environment which necessitates the use of materials and knowledge from other disciplines such as the social sciences.

The curriculum development process of engineering education and its practices, like any other education, if not more, also requires a variety of material, physical, and human “resources” for its proper functioning without which the creation of the needed engineer becomes under a question mark in quantity and quality. The other thing considered in the framework is “mission”. “A mission statement should be the emotional hook which an institution hangs its closing” (Haywood, 2005: 4). Though it is possible for engineering education curriculum development and its practices to have a specific mission peculiar to it, it cannot totally deviate from the overall mission of higher education and somehow be influenced by what is going in it. In addition, the curriculum development process and its practices in general have to come into effect through intelligent, knowledgeable, and skillful leadership. It is a common practice in many sectors, including education, to see the premature fading of beautifully designed plans due to inappropriate leadership and governance. The curriculum development process and practice in engineering education cannot be exceptional to function without being backed with the required leadership and the governance system and practice committed to its materialization. The availability or unavailability of such system at the higher education system level and at the institutional level, in many ways affects the overall curriculum development and its practices.

Engineering education institutions receive their student population from all the schools available in the wider community. Schools at different areas are not the same in their capacity of providing similar education in similar depth, due to different reasons which perhaps pertain to material, physical, and human resources (in terms of the number of teachers and the qualifications they may have). This inevitably creates variation in the students' high school educational background which necessitates bringing and reconsidering the case during curriculum development processes and its practices.

Engineering education, like any other disciplines in higher education, has professionals who strive for maintaining the academic rigor and the scientific quality of the discipline. Functions attached to the discipline, other than that of maintaining such a rigor and keeping the scientific development of the discipline, are sometimes not in agreement with people who would think that engineering education has to produce graduate engineers who would automatically be capable of doing engineering tasks in the real world. The prevalence of such a case somehow can have effect on the curriculum development process and its practices since it entails making choices.

What is shown in the outer most circle of the schematic representation above refers to the outside forces that may put an effect in one or other way on both the higher education system in general and the engineering curriculum and curriculum development process and its practices within particular institutions in particular. These days many countries are trying to produce and advocate for professionals who are capable of doing things in settings other than the setting they are trained for, provided that they maintain the necessary qualification skill and attitude standards. It is argued that engineering education must respond to local challenges as well as global opportunities (Morell, 2008). While this framework is used as a guide to understand what is generally known and related to the field of curriculum development and its practices in engineering education, the qualitative multiple case study research design is described in chapter three of this dissertation and provided the base for the empirical study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1. Introduction

This part deals with the review of literature related to higher education particularly geared to engineering education and its curriculum development process. It begins with the concept and issues of higher education and higher education curriculum development in general and continues to deal with the specific issues related to the issues and concepts of engineering education and curriculum development. Kelly (2004) posits that “one family of issues we must concern ourselves with is that of the lessons which have been learned from the many attempts which have been made to change the curriculum” (Kelly, 2004: 11-12). The review, in general is divided into three major parts. The first part, deals with an overview of the concepts and issues involved in higher education. The second part deals with the concepts and issues related to engineering and curriculum development. Finally, the third part deals with an overview of the development of the education system in Ethiopia.

2.2. Higher Education

Some scholars claim that higher education as a field of study is a “relatively new concept” (Noumi, 2007: 3) which does not encompass a specific body of knowledge and which may be considered as a multidisciplinary subject. Higher education mostly refers to the kind of education provided within or under the settings of universities and colleges. Huber and Harkavy (2007) stipulate that:

The University of the Twenty-first Century is both the essential agent and the distinctive servant of democracy. It is the agent, because its continuing activities nurture deliberation and promote the democratic spirit. It is the servant because, at its best, each of the members – faculty, staff, students, alumni –dedicates his or her professional skills to serving the wider common goal (Huber and Harkavy (2007: 42)

In other words, Giroux (2015) contends that higher education “must be widely understood as a democratic public sphere- a space in which education enables students to develop a keen sense of prophetic justice, claim their moral and political agency, utilize critical analytical skills, and cultivate an ethical sensibility through which they learn to respect the rights of others” (Giroux: 110).

These days, many people attend higher education more than ever. Meyer, Francisco, Richard, and Boli-Bennett (1977), in their cross-national study of tertiary enrollment ratios from 1950 to 1970, found very rapid increases in enrollments in all types of countries. Any institution of higher education is a community dedicated to the pursuit and dissemination of knowledge, the study and clarification of values and to the advancement of the society and its services. The missions of higher education that contribute to social and economic development in the sense of Santiago (2008) are stated as follows:

- *Formulation of human capital (primarily through teaching);*
- *The building of knowledge bases (primarily through research and knowledge development);*
- *The dissemination and use of knowledge (primarily through interactions with knowledge users); and*
- *The maintenance of knowledge (inter- generational storage and transmission of knowledge)* (Santiago, et.al, 2008: 11).

Higher education curriculum around the world is witnessing a significant shift in its expectations to help address immediate and longer-term sustainable development challenges. The sector of higher education, at present, is facing a new era of different reforms and concerns about the quality of education in its institutions and it has become a pressing need for states and society since these institutions are aimed at preparing suitably qualified graduates that have the skills and competencies required by the labor market. Quality in higher education is also believed to be “a multidimensional concept, which should embrace, all its functions, and activities: teaching and academic programs, research and scholarship, staffing, students, buildings, facilities, equipment, services to the community and the academic environment” (UNESCO, 1998b).

Curriculum development is a key educational process for educational developers for schools and for higher education (HE) as it allows an educational course to be designed to meet defined needs. Curriculum development cycles in Higher Education Institutions

(HEIs) have in general become more rapid due to many factors including competition between institutions and the expectations of government, employers and students that higher educational program will provide the most contemporary knowledge in a particular discipline (Roffe, 2010). Since the end of the Second World War, there has been a growing demand to widen access to higher education and change the elitist nature of universities (Guri-Rosenblit, & Sebkova, 2004: 41). This implies that higher education curriculum has to be directed towards meeting societal needs and aspirations in every case. However, it is argued that education cannot be value-free and different value systems or ideologies generate different types of curricula.

The present universities situated all over the world by large have their roots back in the medieval European historical origin and hence “face common contemporary challenges” (Altbach and Davis,). The profound change that became a reality in higher education in the past two decades had made those to grapple with the implications of these changes. Academic institutions and systems have faced pressures of increasing numbers of students and demographic changes, demands for accountability, reconsideration of the social and economic role of higher education, implication of the end of the cold war and the impact of new technologies among others. In other words, the shape and the size of the national higher education systems, as rightly pointed out by Teichler (2004) “are on the crossroads of external expectations and internal dynamics of higher education and are shaped by legitimate influences and interests of society at large” (Teichler, 2004: 2).

The mission of higher education includes educating, training, and undertaking research (UNESCO 1998). If not the latter, the concept of ‘educating’ and ‘training’ obviously entail the use of curriculum because there is no formal education and training which assumes the functioning of an educational institution without the use of some kind of curriculum. Karseth (2006) points out that there are different stakeholders at the international, national and institutional scene: hence, curricular questions are positioned on a “macro”, “meso” and “micro” level and represent contesting and conflicting perspectives (Karseth, 2006).

Irrespective of the bases on which higher education rests and the purposes assumed to it including the efforts made to improve it, it seems that the results are not to the level of satisfaction envisioned by those who are involved in it. For instance, At present," one of the mechanisms underlying policy convergences is the shift in many countries from an emphasis on social or mixed social and economic purposes for education, to predominant economic emphasis" (Ball, 1999).

2.2.1. Curriculum in Higher Education

Even though there is a wide recognition of higher education as an important undertaking in every society and the subsequent growth and development in the infrastructure that allowed and gave opportunity for many people to join it, in many parts of the world, "there is little talk about the curriculum in higher education" (Barnett & Coate, 2005: 1). While the term curriculum is familiar in school education, it seems more ambiguous in its usage in higher education context. As pointed out by Hicks (2007), it is a term given very little currency. "What students should be experiencing is barely a topic for a debate". What building blocks of their courses might be and how they should be put together are even more absent from the general discussion (Barnett & Coate, 2005: 1). To Barnett and Coate "the very idea of curriculum is pretty well missing". Although it is frequently used in academic staff discussions, policy and planning documents, and to describe advisory bodies, its usage is inconsistent and multifarious (Fraser & Bosanquest, 2006) and it seems that the meaning of such a well used word shifts across contexts.

Karseth (2006) views the curriculum in higher education as a social construction where the process of decision-making is seen as socio-political and a cultural process, and contends that "curriculum as a field of study has not played a central role in the research literature on higher education in Europe" (Karseth, 2006: 256). In the United States, at the program level, undergraduate curricula typically consist of three to four components i.e., general or liberal studies, major specializations, which are prescribed by the particular department or program offering the specialization (Spink & Mal, 2013: 33). On the other hand, in professional faculties such as engineering or law, the major and minor fields may be governed by the curricular prescription of the professional field represented or by guidelines extended by the disciplinary associations, or by state licensure requirements or professional board examinations.

In connection with college education, Lattuca and Stark (2009: 4) define the term curriculum as an "academic plan", which implies deliberate planning process that focuses attention on important considerations, and which will vary by field of study, instructors, students, instructional goals and other things. In other words, curriculum, in the context of higher education, is viewed as "the formal academic experience of students pursuing baccalaureate and subordinate degrees" (Clark & Neave, 1992:1566). According to Clark and Neave, undergraduate curriculum is formalized into courses or programs of study including workshops, seminars, colloquia, lecture series, laboratory internship, and field experiences. Course, in this sense, generally refers to designate a formal unit of undergraduate curriculum. These authors also contend that the organization and structure of higher education curriculum is significantly influenced by the historical, social, political and economic contexts of each country in the face of the debate concerning what should be the purpose, content, and structure of undergraduate curriculum. The debate, however, varies in meaning and direction between the developed and the less developed nations. However, within higher education, a faculty member, who organizes a course that refers to a formal unit of undergraduate program, generally controls the purpose, process, and content. Similarly, Ratcliff (1997) defines 'undergraduate curriculum' as:

> *the formal academic experience of students pursuing baccalaureate and less than baccalaureate degrees. Such a curriculum is formalized into courses of programs of study including workshops, seminars, lecture series, laboratory work, internships, and field experiences* (Ratcliff, 1997:6).

This means that the term curriculum in higher education is used either in a limited 'content' focused discussion or it is used as a vehicle for discussion of a particular issue. However, there are definitions of the term 'curriculum' specifically geared to the situation in higher education. For instance, Fraser and Bosanquest (2006), in their study that included 25 interviews found that the term curriculum is conceptualized at four categories:

> *Category A: The structure and content of a unit (subject);*
> *Category B: The structure and content of a program of study;*
> *Category C: The students' experience of learning;*
> *Category D: A dynamic and interactive process of teaching and learning*.

According to these researchers, categories of understanding A and B they conceptualize the curriculum as a product that can be defined and then recorded on paper. These views of curriculum focus on what the teacher as an individual teaches to students, that is, a unit or subject, but also may incorporate the whole program of study undertaken by a student. In category C understanding curriculum is conceptualized as a process and structure that enable student learning, and category D views curriculum as a dynamic, emergent and collaborative process of learning for both students and teachers. The researchers, using the Habermas's theory of 'knowledge-constitutive interest', as expounded by Cornbleth (1999), Grundy, (1987) and Kemmis and Fitzelarence (1980) also analyzed the curriculum in view of technical interest, practical (communicative) interest, and an emancipator interest.

2.2.2. Curriculum Development in Higher Education

Post modern curriculum development in higher education is not seen as permanent but as creative and fluid (Oliver & Hyun, 2011) and it does not focus on specific steps in curriculum development but instead on the relationships of people involved in the process of creating curriculum (Tierney, 1989). Higher education curriculum has historically been considered the work of the faculty. More recently, however, external influences such as society, government, alumni, and others are affecting curriculum development and the curricular change process (Stark & Lattuca, 1997, pp. 98-100).

These days, accreditation bodies expect more from higher educational institutions especially in the area of assessment of student learning in many countries. Such external influence has caused a number of educational institutions to engage in curricular review in an effort to identify the desired student learning outcomes (Alstete, 2004; Lucas, 2000; Wolf & Hughes, 2007). External influences such as Washington Accord (WA) (1989), which is involved in the accreditation of qualifications in professional engineering, the Sydney Accord (SA) (2001) which recognizes equivalence in the accreditation of qualifications in engineering technology, The Dublin Accord (DA) (2002), which is involved in the accreditation of tertiary qualifications in technician engineering can be cited as examples of major influences in this regard.

Curriculum in higher education is usually adapted rather than adopted (Lindquist, 1978 in Clark & Neave 1992: 1574). This is done by any faculty who manage to identify the difference (gap) between what the current curriculum provides and what they think it should provide to the student.

2.2.3. Curriculum Models in Higher Education

As it has been pointed out earlier in this study, the way we conceive the term curriculum determines how curriculum is developed and who is involved in the curriculum. For example Bergquist (1977), based on the rational perspective of curriculum, identified the following curricular models in higher education:

1. *Heritage based: A curriculum designed to inculcate students with a knowledge of the past*
2. *Thematic Based: a specific problem (such as the environment) is identified and studied in-depth.*
3. *Competency Based: students learn specific skills such as proficiency in language and mathematics.*
4. *Career Based: the curriculum is designed to prepare students for a specific career.*
5. *Experience Based: Opportunities are created for the student to learn outside of the classroom.*
6. *Student Based: the curricular emphasis is on providing students with opportunities to control what they learn.*
7. *Value Based: The curriculum emphasizes specific institutional values*
8. *Future Based: the institution divides the curriculum with a concern for what students will need in the future* (Bergquist, 1977: Cited in Tierney, 1995: 35)

Curriculum making, in any way, is not a linear process (Karseth, 2006: 278). A piece of change effected at one level has consequences on other levels, which goes beyond those that are intended to be achieved at the end. However, It has been argued that higher education rests upon two curriculum models, that is , ‘the disciplinary model’, and the ‘vocational/professional model’ (Karseth, 2006: 257). According to Karseth, the disciplinary model has been dominant in university curriculum, although with important exceptions and the vocational model has been traditionally linked to the college sector and undergraduate professional programs. A summary of the disciplinary curriculum model is provided by Karseth (2006) in the following table, (Table 1).

Table 1. Disciplinary Curriculum

Disciplinary curriculum Driving force: The knowledge production itself (cognitive legitimation)			
Structure	Content	Pedagogy	Aims
The disciplines situated in Departments «Subjects» offered on foundational, intermediate- and graduate level	Disciplinary knowledge Emphasis on cognitive coherence	Subject-based teaching Vertical-pedagogic Relations	Content-driven aims, Mastery of conceptual structures, methods and modes of arguments

Source: Karseth (2006: 259)

As pointed out by Karseth (2006), in the disciplinary discourse the main educational pillar is the knowledge structure of the discipline. The central aim is the apprenticeship into conceptual structures and modes of arguments. Hence, education implies a strong emphasis on students' acquisition of theoretical knowledge.

On the other hand, Karseth (2006) contends that the discourse shaping the vocational curriculum model is enunciated by stakeholders who emphasize that education should be an apprenticeship into specific knowledge domains in order to develop specific skills relevant for specific professions as summarized in the following table, (Table 2)

Table 2. Vocational Curriculum

Vocational curriculum Driving force: The need of trained employees for human service, information and production (social legitimation**)**			
Structure	Content	Pedagogy	Aims
Unified cumulative programs Regulated by national core curricula	Multi-disciplinary knowledge Emphasis on the integration of theory and practice	Teacher-based/subject based teaching Apprenticeship: Vertical-pedagogic relations	Vocational-driven aims Mastery of specific skills and a shared knowledge repertoire

Source: Karseth (2006: 260)

According to Karth (2006), the dominant discourses in higher education up to now can be characterized by the two models presented above. Nevertheless, models other than these two also become part of the discourse in higher education. The multidisciplinary model

(Jarning, 2012) in this sense can be seen as an effort to balance professional and disciplinary knowledge cultures. Nevertheless, the two models, that is, disciplinary model, and the vocational/professional models, are being challenged by models such as the multidisciplinary model and by a credit accumulation and transfer discourse advocating global competition and European cooperation (Karth, 2006). As mentioned, modularization is a key characteristic. Its function is to disaggregate traditional extended higher education courses; the specification of outcomes allows modules to be evaluated against each other for the purpose of equivalence. Ensor (2004) argues that the specification of learning outcomes in the credit exchange discourse is not first of all an effort to address issues of quality. It is an attempt to provide mechanism to facilitate the circulation of knowledge in an organized framework.

2.2.4. The Curriculum Development Process and Design in Higher Education

Though little attention has been given to the evolution of curriculum and its review and transformation in institutions (Oliver & Hyun, 2011), higher education curriculum has historically been considered as the work of the faculty. Although colleges and universities are not passive recipients of social pressures, “external influences such as society, government, alumni, and others are affecting curriculum development and the curricular change process” (Lattuca & Stark, 2009: 301).

On the other hand, Oliver & Hyun (2011), in their case study that involved an in-depth interview with 10 curriculum review team members, with regard to the phenomenon of a four-year collaborative curriculum review process between administration and faculty at a higher education institution, showed that a collectively shared guiding vision for the curriculum provided a strong foundation for the comprehensive curriculum review process. Embracing curriculum as a shared responsibility among faculty and administration has led to widespread participation. The collaboration of various groups within the institution in the process promoted organizational change. Cultural issues regarding people and organizational structure served as barriers to the collaboration process, simultaneously the curriculum team's sense of community strengthened the curriculum review process (Oliver & Hyun, 2011).

Beyer and Apple (1998), though not directly related to the curriculum development process in higher education, indicate that "the hallmark of too much curriculum development" had been "insistence on hierarchical top down model of conceptualization, development, and implementation" which they found it intellectually and politically dishonest (Beyer, & Apple 1998: 6). They also clarify that such a "stratified curriculum", which, according to them, is developed by "academics in higher education, research and development agencies and state, and federal departments of education" is a superimposition on teachers.

2.2.5. Curriculum Change and Design in Higher Education

It has been mentioned in the preceding parts of this literature review that there are different curriculum designs which are based and informed by different views and perspectives. Recent development in curriculum design touches every aspect of an institution's core business – from aligning its portfolio of courses to its mission and vision, through market research and product development to quality assurance, recruitment, assessment, resource allocation and timetabling. In this modern era of the 21st century, institutions aim to be increasingly demand led, responsive to cultural and economic change, and capable of providing opportunities for learners to acquire both knowledge and skills for employability and lifelong learning. Joined up, adaptive processes and interoperable systems are vital to the realization of these aims.

One of the curriculum designs pertaining to higher education which is promoted by Morgan and Houghton (2011) and accepted by some other higher education institutions is "inclusive curriculum design in higher education". Inclusive curriculum refers to "the process of developing, designing, and delivering programmers of study to minimize the barriers that students, regardless of educational, dispositional, circumstantial, or cultural background, may face in accessing and engaging with the curriculum" Morgan and

Houghton think that “inclusive curriculum design benefits both staff and students when it is based on principles of equity, collaboration, flexibility and accountability” (Morgan and Houghton 2011: 5). Inclusive curriculum design considers cost and financial implications, embedding student and staff well-being, promoting student engagement, use of technology to enhance learning, responding to different approaches to learning, avoiding stereotypes and celebrating diversity, making reasonable adjustment (Wray, 2013). A number of drivers for change derived from legislation, policy, regulation and procedural requirements constitute a wider context for the inclusive design process.

Curriculum change in higher education may be initiated by those who are involved in planning, administering and implementing a curriculum and somehow dissatisfied in its effectiveness or by those who seek either minor adjustments or major improvements in the existed curriculum. Change in curriculum may also be influenced by external influences. External influences sometimes create “strong current for change” which may or may not be readily accepted by colleges and universities which are not usually regarded as “passive recipients of societal pressures” (Lattuca & Stark 2009: 301). One way of understanding the scope of curricular change, according to Lattuca and Stark, is to consider the extent to which a given change will influence institutional practices. Depth and pervasiveness are identified as measures of such influence. Depth refers to the extent to which a change affects behavior or alters institutional structures, especially those which are capable of changing ones perceptions, values, and assumptions. But such changes are not necessarily wide spread and may affect only a small number of students and faculty in the institution. On the other hand a pervasive change refers to the kind of change that affects many units within a college or university. The following matrix which is adapted by Lattuca and Stark (2009: 304) from Eckel, Hill, and Green (1998) combines these two elements of change.

		Depth	
		Low	High
Pervasiveness	High	Adjustment (1)	Isolated change (2)
	Low	Far-reaching change (3)	Transformational change (4)

Figure 2. Types of Change

Source: Lattuca and Stark (2009: 304)

Routine works of faculty such as making adjustments to existing courses by modifying course content, sequence, instructional processes fall in Quadrant 1. Such adjustments, though they may represent improvement, they may not substantially change the overall academic plan or the learning experiences of students. The type of change identified in Quadrant 2 refers to isolated changes which are high in depth but low on pervasiveness. This type of change refers to a specific type of change applied in one or two units of the institution; not in the entire institution. A change program, such as an online education, when applied across the board within institutions can result in far-reaching change (Quadrant 3). A change type that alters the teaching learning process and the experiences of many students and instructors is termed as transformational change (Quadrant 4).

However, change in curriculum, at the present era, seems to be highly influenced externally by social, cultural, political, and economic demands. A simple illustration of this, without going far away, can be seen from what is stipulated at policy level with regard to the Ethiopian higher education institutions at present. The Convergence Plan adopted in 2008/2009 provided guidance when establishing the 70% and 30% placement objective for sciences & technology (S&T) and social/human sciences (SHS) that forced almost all higher education institutions and universities to work in line with it and restructure their existing programs and/or create new programs and curricula. As a result of implementing this plan, a number of programs/curricula that existed within institutions or within universities faced closure or became malfunctioned. Though not possible to generalize, a large number of undergraduate programs which are provided in public and private higher education institutions hence, have to respond to and/or contribute to the social, cultural, political, and economic needs as per the needs of the country identified by the authorities above.

Curricular change often occurs by diffusion (Lattuca and Stark, (2009). In diffusion theory the movement of influence across the boundary between institutions and their environments can be viewed as stages in change process which includes imitation (or awareness), screening (adaptation), and adoption (confirmation). At the initiation stage of recognition or initial public pressure, external pressures are strong but organizations may resist change, because the need for change is not fully recognized or simply because of organizational inertia. The second stage, which is adaptation, often begins by converting the external influence into an institutional influence. The last stage of adoption or confirmation is reached when the degree of acceptance is sufficiently great and when the influence may no longer be viewed as external; it is now part of the institution's agenda.

2.2.6. Teaching and Learning in Higher Education

In any formal educational setting, particularly where the actual implementation of the curriculum takes place the direct actors in the process of education are teachers and students. In this process, teachers deliver or initiate materials that contain new concepts and principles that are not well known or that are not learned by the students before, to be learned, and students learn what is presented or initiated by the teacher together with whatever more they want to lean. In fact, students learn in many ways—"by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing" (Felder & Henriques, 1995: 22). Though the "heart of education is learning, not teaching" (Knowles, 1973: 41), it is an inevitable fact in any formal education that the teacher takes the lead in initiating the discussion and presenting the materials of learning. Hence, the following part deals with a brief description of the teaching learning process in higher education.

As it has been mentioned elsewhere in this review of literature, teaching involves an interaction between an individual who is involved in teaching something to someone; usually to a group of people who are available to learn that something. Any teaching staff in higher education knows that it is not so easy to decide what works and what does not work in the teaching learning process. Unfortunately, teaching staff in higher education, in most cases, are often left to develop their understanding of the teaching profession on their own (Berthiaume, 2003: 215). It is also a recognized fact that some academics teach students without having much formal knowledge of how students learn (Fry, Ketteridge, & Marshall, 2009: 8). Teaching in higher education draws on knowledge of three areas, namely knowledge about one's discipline, generic principles and ideas about teaching and learning. An awareness of the theories of learning can provide some insight into understanding how university or higher education students learn. Most of the learners in higher education are young adults whose age is 18 and above. The theory of Andragogy (Knowles, 1973) informs us that adult's individual self-concept, experience, readiness to lean and orientation to learning differs from that of children's below adult age. The same theory also points out that:

> *as an individual matures, his need and capacity to-self directing, to utilize his experience in learning, to identify his own readiness to learn, and to organize his learning around life problems, increases steadily from infancy to pre-adolescence, and then increasingly rapidly during adolescence* (Knowles 1973: 46).

As students mature, it is likely that sharp contrasts develop between their present and their childhood learning styles. These differences occur in motivation, in learning skills, in amount and variety of knowledge, in desires for learning, in self-concept and in need for immediacy of application. Teaching such students, is not an easy task for it requires a special attention commensurate to the needs students have.

Available literature in higher education also indicates that recently more attention is given to the quality of teaching offered to the students in higher education. The advent of mass higher education, the value for money and public accountability, and the change in the student body produced a shift in the conception of the role of universities. Brennan, King and Lebeau (2004) recognize that universities are as much the 'takers' of change as its agent, and are influenced by globalization, democratization, 'supra-statism' and modeling, knowledge economies, liberalization, regulation and accountability.

And yet the question of quality in education is one of the central questions that capture the mind of all stakeholders in higher education. Quality teaching depends on the meaning one chooses to give to the concept of quality. Quality, as pointed out by Biggs (2001) can alternatively define an outcome, a property, or a process. When it comes to quality teaching, Harvey and Green (1993) distinguish four definitions of quality that can help us to understand what Quality Teaching might be; that is, quality as "excellence"- which is dominant in many old elite higher education institutions, quality as "value for money"- one that satisfies the demands of public accountability, quality as "fitness for purpose" that refers to the purpose of the institution, and quality as "transforming". According to this definition, Quality Teaching is teaching that transforms students' perceptions and the way they go about applying their knowledge to real world problems. Hau (1996) argues that quality in higher education and quality teaching in particular, springs from a never-ending process of reduction and elimination of defects.

Different teachers use different methods in their teaching. For some teachers lecturing is more convenient while others prefer demonstrating or conveying student discussion. Others may prefer focusing on principles while some others deal with applications. Some emphasize memory and others understanding. However, "how much a given student learns in a class is governed in part by that student's native ability and prior preparation but also by the compatibility of his or her learning style and the instructor's teaching style" (Felder & Silverman, 1988: 674). Research on teaching styles at all levels of education suggests that individuals' beliefs about teaching are deeply held and enduring, even when those beliefs are contradicted by reason, experience, and schooling (Floden, 1995: cited in Lattuca & Stark, 2009: 184). Hence, knowledge about how students learn can be regarded as the most crucial element for teaching students of varying ages including students in higher education.

2.2.6.1. Learning in Higher Education

When talking about learning in higher education, we are talking about individuals whose age is eighteen years and above. As it has been mentioned in the preceding part of this discussion adult's individual self-concept, experience, readiness to lean and orientation to learning differs from that of children's below adult age. In a structured teaching and learning setting, learning is thought as a two-step process involving the reception and processing of information (Felder and Silverman, 1988).

Learning is about how we perceive and understand the world, about making meaning (Marton and Booth, 1997). But 'learning' also involves mastering abstract principles, understanding proofs, remembering factual information, acquiring methods, techniques and approaches, recognition, reasoning, debating ideas, or developing behavior appropriate to specific situations; it is about change (Fry, et al. 2009). However, despite many years of research into learning and suggestions of various natures, it is not easy to translate the knowledge obtained through research into practical implications for teaching. So far, there are no simple and clear answers to the questions 'how do we learn?' and 'how as teachers can we bring about learning?' (Wankat & Oreovicz, 1993). This is partly because education deals with specific purposes and contexts that differ from each other and with students as people, who are diverse in all respects and ever changing and which is more evident in the Ethiopian situation than any place with less diversity. Not everyone learns in the same way, or equally readily about all types of material. The discipline and level of material to be learnt have an influence. No matter in which level they are, students always bring different backgrounds and expectations to learning. Our knowledge about the relationship between teaching and learning is incomplete and the attitudes and actions of both students and teachers affect the outcome, but we do know enough to make some firm statements about types of action that will usually be helpful in enabling learning to happen. In this chapter some of the major learning theories that are relevant to higher education are introduced.

2.2.6.2. Assessing Student Learning in Higher Education

Irrespective of the variety of meanings attributed to it, the term assessment usually refers to the systematic collection and analysis of information to improve student learning. Lattuca and Stark (2009) refer to the evaluation which is aimed at decision making, improvement, and the planning of future courses and programs as "formative". Such evaluation, according to these authors, "may include measurement of student outcomes (assessment) and satisfaction (student-centered evaluation) as well as estimates of how faculty themselves believe the plan (professional judgment)" (Lattuca & Stark, 2009: 233). Formative evaluation often arise from faculty initiative and the procedure used to perform it may range from informal to formal and from unstructured to structured.

The word “assessment” has taken on a variety of meanings within higher education. The term can refer to the process faculty use to grade student course assignments, to standardized testing imposed on institutions as part of increased pressure for external accountability, or to any activity designed to collect information on the success of a program, course, or university curriculum. Formative assessment is a process in which teachers use various tools and strategies to determine what students know, identify gaps in understanding, and plan future instruction to improve learning. Biggs (2003) suggests the alignment of teaching and assessment to curriculum objectives. According to Biggs, the integration of teaching and assessment, which he calls Constructive Alignment (CA), supports high level learning. Different forms of assessment, from performance-based to multiple-choice items can be used in formative assessment. These may include journals, checklists, written papers, and other relevant techniques. The time for assessment ranges from minutes of assessment to hour/s taking tests and examination. The learning point associates (2009) describe the purpose of assessment as follows:

> *The purpose of the assessment items, tasks, or activities must be that they are windows into the students’ cognitive processes. Assessments that allow students to show their thinking, and allow teachers to best elicit evidence about these cognitive processes, are where the emphasis should be* (Learning Point Associates, 2009: 1).

In general, it can be said that assessment deals with identifying the gap between what students have to learn and what they actually learned. Its purpose is mainly to give feedback to students so that they could improve their learning and improve the quality of their education.

2.3. Engineering Education

Engineering education, irrespective of its peculiar characteristics, as part of higher education, shares much of the common attributes discussed in connection with curriculum and curriculum development, especially as related to higher education. The Merriam Webster Dictionary defines the term “engineering” in various ways, one of which is “the activities or function of engineer”, where an engineer is defined as “designer or builder of engines” or “a person who is trained in or follows as a profession a branch of engineering". Engineering is also understood as the application of science to the optimum conversion of the resource of nature to the uses of humankind (Smith, 1962).

Engineering, in the sense of UNESCO is the field of discipline, practice, profession and art that relates to the development, acquisition and application of technical, scientific and mathematical knowledge about the understanding, design, development, invention, innovation and use of materials, machines, structures, systems, and processes for specific purposes (UNESCO, 2010). Engineering and technology are critical inputs for economic development and competitiveness hence, a nation's educational program should, among other things, be aimed at solving the problems facing the nation and improving the economy through wealth creation (Luiz, et al. 2004).

Higher education institutions, in general, are required to educate and train personalities who would be able not only to think individually and creatively but also to act successfully and compete individually or in groups in both national and foreign labor market. Engineering education as part of higher education occupies one of the central positions in such expectations. Concern about engineering education obviously entails the preparation and equipping of young people to be able, understand and act effectively in the design and production of improved artifacts and modern services through the use of science and mathematics to make the human life easier and comfortable and to contribute to the future development of the engineering profession within the society into which it is provided and beyond.

Richard Felder in his article "Engineering Education: A Tale of Two Paradigms" points out that "Engineering education is in a turbulent period" (Felder 2012: 1). Pressures to reform engineering education have existed since the field first began, but a particularly intense series of them arose in the 1980s and still continues. Felder posit what this means as the following:

> *chronic industry complaints about skill deficiencies in engineering graduates, high attrition rates of engineering students, the worldwide of outcomes-based engineering program accreditation, and deficiencies revealed through the research findings of both cognitive science and many educational research studies are all provoked calls for changes in how engineering curricula are*

structured, delivered, and assessed. The ongoing debate involves four focal issues: how engineering curricula should be structured, how engineering courses should be taught and assessed, who should teach, and how the teachers should be prepared (Felder, 2012: 1).

Felder describes the traditional approach to curriculum as "trust me" didactic approach which begins teaching the first years with basic mathematics and science and proceeds to "engineering science" in years 2 and 3 and finally to realistic engineering problems and practice later in the capstone. On the contrary, the integrated approach suggests to introduce engineering problems and projects starting year one, and bring in the math and science (and communication and economics and ethics) in the context of problems. According to Felder this means the emerging paradigm infuses the entire engineering curriculum with real engineering problems and introduces fundamental material on a need-to know basis in the context of solving those problems (Felder, 2012: 3).

A similar idea is promoted by Prados (1998). In his view, engineering education has to have the needed characteristics of the new engineering paradigm which include:

- *an engineering faculty dedicated to developing emerging professionals-not merely filling empty heads with knowledge*
- *a curriculum that maintains a solid mathematical and scientific knowledge base*
- *an educational structure that integrates subject matter, and shows relationships among subject areas from the beginning of each student's program*
- *educational methods that stress active learning, emphasize industry-based projects, and depend much less on lectures*
- *strong emphasis on communication, teamwork, and group problem-solving skills*
- *a diverse student population*
- *regular, well-planned interaction with industry* (Prados, 1998: 1)..

Engineering and engineering curriculum within higher education system are also perceived in different ways by different people. Dym, Gogino, Eris, Frey and Leifer, (2005), for instance, associate engineering education with graduate engineers "who can design, and that design thinking is complex". These authors consider design as the central or distinguishing activity of engineering and that engineering programs should graduate engineers who can design effective solutions to meet social needs. The definition they provide for engineering design is as follows:

Engineering design is a systematic, intelligent process in which designers generate, evaluate, and specify concepts for devices, systems, or processes whose form and function achieve clients' *objectives or users' needs while satisfying a specified set of constraints* (Dym et. al, 2004: 309).

According to Dym et al, design problems reflect the fact that the designer has a client (or customer) that, in turn, has in mind a set of users (or customers) for whose benefit the designed artifact is being developed. Mourtos, (2013) also considers design as the heart of engineering practice. In other words, for Crawley, et al, the essential task of engineering is to design and implement solutions that have not previously existed (Crawley, et.al. 2008). The purpose of engineering education, according to Crawley et.al, is "to provide learning required by students to become successful engineers, that is, technical expertise social awareness and a bias toward innovation" (Crawley, et. al. 2008: 1). The Conceive-Design-Implement-Operate (CDIO) approach which Crawley et.al promote builds on stakeholder input to identify the learning needs of students in a program and construct a sequence of integrated learning experiences to meet those needs. The CDIO initiative, according to Crawley et.al, was launched in the year 2000 as a major international project to reform undergraduate engineering education. The goals of CDIO, as pointed out by Crawley et.al have been to:

- *Master a deep working knowledge of technical fundamentals*
- *Lead in creation and operation of new products and systems*
- *Understand the importance and strategic impact of research and technological development on society* (Crawley et.al, 2008: 269).

The CDIO initiative has 12 standards that distinguish and describe CDIO programs which were developed in response to program leaders, alumni, and industrial partners who wanted to know how they would recognize CDIO programs and their graduates. The standards were:

Standard 1– *The Context: adoption of the principle that product, process and system lifecycle development and deployment –Conceiving, Designing, Implementing and Operating – are the context for engineering education. (p. 270).*

Standard 2 – *specific detailed learning outcomes for personal and interpersonal skills, and product, process and system building skills, as well as disciplinary knowledge, consistent with program goals and validated by program stakeholders.*

Standard 3 – *integrated curriculum – a curriculum designed with mutually supporting disciplinary courses, with an explicit plan to integrate personal and interpersonal skills, and product, process and system building process.*

Standard 4 – *Introduction to Engineering – An introductory course that provides the framework for engineering practice in product, process and system building and introduces essential personal and interpersonal skills*

Standard 6 – Engineering Workspaces – engineering workspaces and laboratories that support and encourage hands-on learning of product, process, and system building, disciplinary knowledge and social learning
Standard 7 – Integrated Learning Experiences – integrated learning experiences that lead to the acquisition of disciplinary knowledge as well as personal and interpersonal skills, and product process, and system building skills
Standard 8 – Active Learning – teaching and learning based on active experiential learning methods
Standard 9 – Enhancement of Faculty Skill Competence – actions that enhance faculty competence in personal and interpersonal skills, and product, process, and system building skills
Standard 10 – Enhancement of Faculty Teaching Competence – Actions that enhance faculty competence in providing integrated learning experiences, in using active experiential learning methods, and in assessing student learning
Standard 11 – Learning Assessment – Assessment of student learning in personal skills and product, process, and system building skills, as well as in disciplinary knowledge
Standard 12 – Program Evaluation – A system that evaluates programs against these 12 standards, and provides feedback to students, faculty, and other stakeholders for the purpose of continuous improvement. (Crawley et.al, 2008: 270-278).

Engineering education programs, in various contexts and in varying degrees of depth and width, provide students with the knowledge, understanding, skills and competencies required to the professional engineers. The objective of engineering education is to prepare students who are deeply knowledgeable of the technical fundamentals and broadly prepared with the pre-professional skills of engineering (Crawley, et.al, 2008). As pointed out by Rugarcia, Felder, Woods, and Stice (2000), "knowledge is the data base of a professional engineer; skills are the tools used to manipulate the knowledge in order to meet a goal dictated or strongly influenced by the attitudes".

According to Crawley et.al (2008), the proper context for engineering education is engineering practice, that is, lifecycle development and deployment of products, processes, and systems. Engineering education provisions generally include scientific and mathematical theory, engineering applications, design, communication skills and problem solving skills, and so on. The emphasis and the magnitude of the proportion in these elements, however, kept changing over time in the past as well as at present (Lattuca, et al., 2012).

Pister (1993) pointed out that "the practice of engineering in society requires a set of individuals (people) who are subjected to a process called engineering education, whose goals may (or should) include: acquisition of knowledge development of understanding acquisition and application of skills" (Pister, 1993). The modern engineering profession deals constantly with uncertainty and with conflicting demands from clients, governments, environmental groups and the general public. It requires skills in human relations as well as technical competence. Whilst trying to incorporate more "human" skills into their knowledge base and professional practice, today's engineers must also cope with continual technological and organizational change in the workplace (Mills, 2003).

2.3.1. Engineering Curriculum and Curriculum Development Process

The Accreditation Board for Engineering and Technology (ABET) in the U.S. case, refers to an 'Approved Engineering Curriculum' as 'any curriculum under ABET accredited engineering program leading to a baccalaureate degree in engineering'. According to ABET, it is a program leading to a four-year degree or a baccalaureate degree in technology (ABET).

Many writers in the area of engineering education point out that over the last fifty years engineering curricula have been based largely on an 'engineering science' model (Lattuca et al. 2009; Dym, et.al. 2005; Prados, 1998; Felder,). In this model, engineering is taught only after a solid basis in science and mathematics, of which the first two years are devoted primarily to the basic sciences. Such curricula, however, have not been without challenges since the 1950s. Few among other challenges were that engineering graduates who were the results of such curricula were perceived by industry and academia as being unable to practice in industry because of the change of focus from the practical (including drawing and shop) to theoretical (Lattuca, 2006: 5; Dym, et.al. 2005: 103). Hence, what is now identified as the "capstone (design) course" which eventually became the standard academic response which involved projects devised by faculty to industry- sponsored projects and where companies provide "real" problems, along with expertise and financial support. The infusion of first-year design courses that dubbed "cornerstone (design) courses" in 1990s and was motivated by an awareness of the curricular disconnect with first-year students who often did not see any engineering faculty for most of their first two years of study. During this period first-year project and design courses emerged as a means for students to be exposed to some flavor of what engineers actually do while enjoying an experience where they could learn the basic elements of the design process by doing real design projects.

Curriculum is also regarded as the product of the culture and values in which they are embedded (Haywood, 2005). According to Haywood this fact makes the transplantation of educational practices of one country to another is difficult. Haywood in addition identifies three paradigms of curricula in engineering, i.e., 'received', 'reflective' and 'restructuring' after Eggleston (1977). The received paradigm, according Haywood, describes a curriculum organization designed to meet the belief that there is a received body of understanding which is "given" even ascribed. It is predominantly non-negotiable. Most engineering curricula are primarily of this kind, although some negotiation may be allowed, and to this extent they are reflexive" (Heywood, 2005). In other words Petrina (2007) point out that "curriculum and instruction (C&I) are inseparable"

Even though the thinking and skill of "design" is closely associated with engineers, according to Rompelman and Graaff (2006), engineers seldom put their design skills into practice when they are faced with the task to develop a new course program or the innovation of an existing curriculum. According to Rompelman and Graaff (2006), the principles that can be used for any purposeful design can also be applied to curriculum. They suggest that the knowledge and skills that can be applied in the design of any purposeful project can be used for designing curriculum.

In engineering education, writing the aims and objectives or "outcomes" is said to be the starting point for curriculum development (Haywood, 2005: 19). Currently, engineering educators are required to state the outcomes. Many engineering educators who were inflected by Bloom's Taxonomy of Educational Objectives for cognitive domain continued to use it in its original form (Haywood, 2005: 19). Bloom's (1956) six levels of cognitive learning which include “Knowledge” which refers to the remembering of previously learned material, “Comprehension” which refers to the ability to grasp the meaning of previously learned material, “Application” the ability to use the learned material in new and concrete situations, “Analysis” the ability to break down material into its component parts so that its organizational structure may be understood, “Synthesis” the ability to put parts together to form a new whole, and finally “Evaluation” the ability to judge the value of material for a given purpose. According to Haywood, there is little doubt that the so called “outcomes movement” has its origins in The Taxonomy of Educational Objectives.

2.3.2. Curriculum Design in Engineering Education

As it has been seen earlier in this study, curriculum is taken as the formal mechanism through which intended educational aims are achieved. Achievement in the sense of this research refers to the students’ construction of knowledge, skills, and attitudes based on their prior knowledge and are able to do what they are supposed to do. Curriculum incorporates the social, cultural and even political background of the program of a course. In the end, this formal mechanism includes two prime factors: instruction and learning and the issues of curriculum design have become a central paradigm in engineering education. Curriculum issues are inseparably linked to current thinking and action on educational concerns and reforms around the world. For instance, the imposition of General Agreement on Trade in Services (GATS) regime (Robertson, 2006) in the education sector necessitates enrichment and broadening of engineering curricula so that engineers will be better prepared to work in a changing global economy.

Accords & treaties like the Washington (1989), The Sydney Accord (2001), The Dublin Accord (2002), & The Bologna Process (1999) and others have been agreed upon to homogenize curriculum. Even though Ethiopia is not an official member of such groups at the moment and did not sign any of the treaties, it is obvious that it would be influenced by those ideas as long as curriculum development is backed financially by the government and technically supported by foreign advisors.

2.3.3. Teaching and Learning in Engineering Education

If engineers have to do what is expected of them properly and meet the demands of society in solving the problems it may have, they must learn the knowledge and acquire the skills that is required by the engineering profession. Without such proper knowledge and skill of engineering it is unlikely that problems that require engineering solution would be solved persistently in a way it assures sustainability. The acquisition of such knowledge and skill by the students, in part depends on what teachers offer to their students (Felder & Brent, 2005: 57). Even though this is a widely recognized view of the significance of the teacher within the process of teaching and learning, college teaching may be the only skilled profession that does not routinely provide training to its novice practitioners (Brent, & Felder, 2000). According to Brent and Felder, teachers:

> *had to teach themselves how to devise stimulating lectures and rigorous but fair assignments and tests, how to motivate students to want to learn and how to make them active participants in the learning process, and how to help them develop critical problem-solving, communication, and teamwork skills* (Brent &Felder, 2000).

It is believed that the best method of teaching in undergraduate level is induction (Felder, 2002) whether it is called problem-based learning, discovery learning, inquiry learning, or some variation on those themes. In these methods students are presented with a challenge and then learn what they need to know to address that challenge. The methods, however, differ in the nature and scope of the challenge and in the amount of guidance students receive from their instructor as they attempt to complete their tasks (Felder & Prince, 2007). In other words, in most cases, the traditional college teaching method is deduction, which starts with "fundamentals" and proceeds to applications. Many students prefer deductive presentation than inductive approach (Felder, 2002).

Hence, instructors who set out to implement an inductive method should therefore, first familiarize themselves with best practices in using these methods, such as providing adequate scaffolding—extensive support and guidance when students are first introduced to the methods and gradual withdrawal of support as students gain more experience and confidence in its use. They should also anticipate some student resistance to the method and be aware of effective strategies for defusing it. If these precautions are taken, both the students and the instructors should soon start seeing the positive outcomes promised by the research.

One of the approaches to problem based teaching is exposing students to industries in the form of internship. Some findings indicate that internships have fast become an integral component of many academic programs, offering benefits to all participating parties: students, schools and employers. For some engineering institutions elsewhere, internship programs are mandatory (Trotskovsky & Sabag, 2014). However, care must be taken in the design and implementation of such programs and evaluations should be conducted on a regular basis to ensure that the internship program and academic curricula are meeting industry demands.

Engineering education curricula, in the Ethiopian context also put internship as one of the important element for student learning. It is thought that the students' exposure to industry serves two major functions among others. The first and the most important is its use as means of introducing students to the real work situation. Secondly, it is also believed that it fills the skill gap students might have during their in-campus education. Since there is no meaningful research on how properly it is implemented and its impacts in general, much cannot be said about it.

2.3.3.1. Student's learning in Engineering Education

Interest in student centered education has become a phenomenon that attracts many of those who are involved in the business of education and teaching-learning of every level (Felder and Silverman, 1988; Murr, 1988; Waldron, 1986, Kolb, 1984, 1985; Spencer & Mehler, 2013). For instance, Kolb (1984, 1985) developed a two-dimensional circular or three-dimensional spiral model of how people learn (Felder and Silverman, 1988). The first of Kolb's model refers to active experimentation (AE) versus reflective observation (RO) that indicates to how individuals prefer to transform experience into knowledge. Individuals who favor active experimentation like to get things done and see results. Reflective observers prefer to examine ideas from several angles and to delay action. The second dimension in Kolb's theory refers to the dichotomy between abstract conceptualization (AC) and concrete experience (CE). This dimension distinguishes between how an individual grasps or takes in information. Abstract conceptualizers prefer logical analysis, abstract thinking, and systematic planning. Individuals who favor concrete experience want specific experiences and personal involvement, particularly with people, and tend to be nonsystematic.

Spencer and Mehler (2013) pointed out that the goal of science education should be to help students develop four aspects of scientific proficiency, the ability to (i) know, use, and interpret scientific explanations of the natural world; (ii) generate and evaluate scientific evidence and explanations; (iii) understand the nature and development of scientific knowledge; and (iv) participate productively in scientific practices and discourse (Spencer and Mehler, 2013: 25). According to these authors, such an approach to science teaching will require a shift from the teacher-centered instruction (which was the common practice in science classrooms in the past) to more student-centered methods of instruction. So, the defining feature of these instructional methods, as stipulated by Spencer and Mehler, is who is doing the sense-making. In the teacher-centered instruction the sense-making is accomplished by the teacher and transmitted to students through lecture, textbooks, and confirmatory activities in which each step is specified by the teacher. In these classrooms, the instructional goal is to help students know scientific explanations, which is only part of the first aspect of scientific proficiency. In student-centered instruction, the sense-making rests with the students, and the teacher acts as a facilitator to support the learning as students engage in scientific practices.

Wankat & Oreovicz (1993) associate the act of student learning with the “disequilibrium caused by new data which cannot be explained by the old model and which leaves the students with the inability to solve required problems with the help of their previous knowledge” (Wankat & Oreovicz, 1993: 284). According to these authors, student learning takes place within the individual and it takes place when the individual thinks it is new and useful and when they are incapable of solving problems with the knowledge and skill they know before. The usual lecture-homework sequence requires formal operations. For instance, students who are still in the concrete operational stage (Piaget,

1954) in physics have difficulty revising their knowledge structures. For those in this stage, the concrete operations of the laboratory can be instrumental in helping them accept the new organization of knowledge. The laboratory exercise has other advantages as well. In the laboratory the student must be active, unlike in a lecture where a passive approach is allowed and often encouraged. Reconstruction requires active mental effort by the student. The laboratory is also often a group activity which encourages students to discuss their understanding of physics actively, and the experience provides support from the group. The traditional model focuses on the delivery system and not on the learner. In the traditional view knowledge exists independent of the individual and the mind of the learner is a “tabula rasa”, a blank tablet, upon which a picture of reality can be painted. In this model learning takes place if the student is attentive, when the teacher unloads his or her almost perfect picture of reality through well designed and well presented lectures. But on the contrary, the constructivist theory says the tablets are not initially blank and only the individual can do the writing.

The other crucial thing for student learning is motivation. Even though much of this motivation is beyond the teacher’s control, he or she can do a great deal either to motivate or de-motivate students. Motivation is usually considered either intrinsic (internal) or extrinsic (externally controlled) and which includes many things that the instructor can do, including grading, providing encouragement and friendship, and so forth.

2.3.3.2. Assessment and Evaluation in Engineering

Olds, Moskal, and Miller (2005) defined the term assessment as an “act of collecting data or evidence that can be used to answer classroom, curricular, or research questions” (Olds, Moskal, and Miller 2005: 23). These authors, in addition, define what an assessment method is. An assessment method, according to Olds, et al. (2005), refers to the procedures used to support the collection of data for assessment purposes. The starting point for reaching to an effective assessment results is having clear goals (Angelo & Cross, 1993). It requires answering questions related to what is most important to teach and what students should really learn. According to Angelo & Cross (1993), there are different techniques of assessment which are related to the assessment of course-related knowledge and skills, skill in analysis and critical thinking, skill in synthesis and creative thinking, skill in problem solving, skill in application and performance, learner attitudes, values, and self-awareness, and learner reactions to class activities. Angelo & Cross base their model of classroom assessment on seven assumptions of the following:

- *The quality of student learning is directly, although not exclusively, related to the quality of teaching. Therefore, one of the most promising ways to improve learning is to improve teaching;*
- *To improve their effectiveness, teachers need first to make their goals and objectives explicit and then get specific, comprehensible feedback on the extent to which they are achieving those goals and objectives;*
- *To improve their learning, students need to receive appropriate and focused feedback rarely and often; they also need to learn how assess their own learning;*
- *The type of assessment most likely to improve teaching and learning is that conducted by faculty to answer questions they themselves have formulated in response to issues or problem in their own teaching.*
- *Systematic inquiry and intellectual challenge are powerful courses of motivation, growth, and renewal for college teachers, and classroom assessment can provide such challenge;*
- *Classroom assessment does not require specialized training, it can be carried out by dedicated teachers from all disciplines;*
- *By collaborating with colleagues and actively involving students in classroom Assessment efforts, faculty (and students) enhances learning and personal satisfaction* (Angelo & Cross, 1993).

1.5. The Development of Education in Ethiopia: A Milieu for Engineering Curriculum Development Process

Richard Hooper (1972: 2) indicates “at a time of controversy, ‘tradition’ is quoted as a defense against change. An important way of setting the context within which curriculum can be studied is to analyze ‘tradition”, in this quotation Hopper calls for the attention of those who are involved in the study of curriculum, that they need to be concerned and analyze the inherited, established, or customary pattern of thought, action, or behavior to understand the present. This researcher thinks that this has to do well in the case of the Ethiopian education and curriculum development systems because he believes that the starting point for the Ethiopian education system is not the introduction of the western type modern education. Any curriculum research undertaking that neglects the previous experiences (which may be strong or weak) and focuses solely on the present, somehow misses some important elements that connect the past with the present or that may be drawn from the past. It is believed that “curriculum is socially and historically located and culturally determined (Hooper, 1971:2). The study of any curriculum development and practical undertaking does not develop in a vacuum but proceeds based on beliefs—seldom made explicit about how people learn what human beings should be like, and what society is.

To begin with, it is a well-recognized fact that Ethiopia has a long history of education, teaching and learning, and assessment (Amare, 2005; Alemayehu & Lasser, 2012). The very existence of what we call education and its process, be it traditional, elementary, secondary, tertiary, or engineering, physics, chemistry, and others, is not a onetime development process and activity. It is a dynamic process, that grows and develops through time and nested within the culture of society and regenerate itself continuously from time to time as the society and its culture grows and changes. The beliefs that gave rise to the very existence of the education system in Ethiopia in general, and modern education in particular, and the process by which it was made to exist and develop together form the milieu of education in Ethiopia including engineering education. Hence, a brief look to the past evolvement of education in Ethiopia and its process may give us an opportunity to pick some elements that may facilitate or hinder our present action in our general or specialized education system and act upon it in accordance.

Ethiopia is a country located in North Eastern part of Africa. Its surface area covers a total of 1.125 square kilometer. Its climate varies from temperate in the highlands to tropical in the lowlands. Ethiopia is the second most populous country in Africa (World Bank indicators, 2010) next to Nigeria comprising a total population of 82.95 million. Of these, 48,561,390 are in the school age range of year 4 to 21 (Calculated from MoE (2010) Education Statistics Annual Abstract, 2002 E.C.). Of the total school age group, 28,750,782 are males and 19,810,608 are females. Different nations and nationalities residing within the country’s territory are the core for the county’s political, economic, and social structures that identify the country as the Federal Democratic Republic of Ethiopia. Ethiopia had its own education system, that served the Ethiopian Orthodox Church and the elite groups affiliated to it and which is different from the western type of modern education, even long before the introduction of modern education (Amare, 2005; Solomon, 2008).

Though the western culture of the natural and applied sciences seems to shape and be the dominant influence of the present modern education system in Ethiopia, it cannot be said that the western culture of education is the only influence that shapes the Ethiopian education system as a whole. This means even professional education such as engineering education and others, as part of the whole system are influenced by the influences that shaped the whole system of education. Anyhow, the intention in this part of the study is not to give an in-depth account of this line of argument; it is, just to indicate that the Ethiopian education system is influenced not only by the western culture of education but also by the Ethiopian culture of education.

2.4.1. Traditional Education

As it is mentioned herein above, the aim in this section of the study is not to give a detailed account and analysis of the traditional education. Rather, it is to give a brief highlight of the development of the Ethiopian education system and the practices of curriculum development evolved through time with the assumption of connecting the past with the present in terms of the concept of education, curriculum, curriculum development, and its implementation.

Scholars in the field of education inform us that Ethiopia has a long history of traditional education that began and subsequently developed under the realm of religion. It existed mainly as church education or as Koranic education. Though there were some evidences of what was included, in these type of education (Amare, 2005), the details of how it was organized, the bases for its content selection and sequencing, and the like seems to be less known and require more research. Nevertheless, Ethiopia "has had its own indigenous education and curriculum" (Solomon, 2008: 34; Amare, 2005) prior to the introduction of the western type of modern education and its influences are still visible in the education system in many respects.

2.4.2. The Development of the Ethiopian Modern Education

Many scholars, in one way or another, have dealt with the history, nature, and characteristics of the Ethiopian education. (Maaza Bekele, 1962; Girma Amare, 1967; Pankhurst, R. 1974; Teshome G. Wagaw, 1979; Amare Asgedom, 1995 and Tekeste Negash, 1996) are among many others in this regard. This, by no means, is not to claim for exhaustiveness. Ethiopia has a long history of education in general, and a form of education of different types and different levels peculiar to its own. The nature and the history of higher education, as related to Ethiopia are documented in Amare (2005). The concept and practice of structured traditional and formal education was well developed in certain parts of the country even before the introduction of the European type of education (Amare, 2005). In spite of this fact, indigenous education by large still remains to be an important transmitter of cultural identity from one generation to the next among many ethnic and linguistic groups (Derebssa, 2006: 62; World Bank, 2013). Formalized education in its traditional form, though not accessible for the large number of Ethiopians, existed since the fourth century A.D., and survived as a means for transmitting the long lived Christian and Islamic religious cultures and skills associated with them until the end of the19th century. Since the beginning of the sixth century, the Ethiopian Orthodox Church had maintained a highly structured organized system of education. The Islamic religious education also existed and developed probably starting from the 7th century (Amare 2005). The education, especially the church education, provided throughout those earlier days, was mainly elite education (Saint, 2004; Teklehaimanot, 1999) which was linked to the Orthodox Church and it was meant to serve the functions associated with Christian religious tasks. Likewise, the Koranic schools that were attached to and promoted by the centers of Islamic faith used to have a parallel function in spreading the reading and writing of Arabic, the study of Islamic philosophy and law and the teaching of the Koran (Amare, 2005).

Even though practical and accumulated wisdom and experiences were passed from generation to generation through the formal religious institutions mentioned herein above in certain limited parts of the country, in many of the social groups of Ethiopia the traditional/indigenous education process was also institutionalized in an age - grade system that ensured the continuity of experience and organization.

The process in the introduction of programs and structures of teaching and learning that differed fundamentally from the traditional, religious based system was not really officially initiated until the very end of the nineteenth century. At the beginning of the twentieth century, the establishment and growing of urban seat of power or “the need to preserve a modernized centralized power” (Mekasha, 2005; Alemayehu & Lasser, 2012), and other factors, such as the arrival of foreign embassies and the beginnings of new features of commerce and manufacturing, combined together prompted and necessitated the beginning and promotion of a different pattern of education (Tekeste, 1996: 13).

The provision of modern education in Ethiopia officially began in the year 1908 with the opening of Minilik II School in Addis Ababa, marking a significant step in the history of education in the country. It had been followed with the additions of more schools soon after. The content of the curriculum, within the new school system included Amharic, Geez, Arabic, Italian, French and English (MoE, 1984). Simply by looking into such provision of education, it would not be difficult to understand what the emphasis of education was and what was needed by educating youngsters. The emphasis on language teaching clearly entails that the need was on communication skills. But here one could raise a mega question ‘whose need was served by such curricula? And who steered the initiative to produce the curricula?’ This researcher believes that the system established at that point in time had set the Ethiopian education context which still has an impact on our current education system in many ways. Such question might have been addressed by researchers in the field, if not, or as complementary note, this researcher would like to suggest the importance of conducting research that involves parents, students and the wider public with regard to the kind of education they need. How do parents judge the quality of a school these days in Ethiopia? And how do these parents judge their children’s education and pay more money for it in the form of tuition fee? How do private schools attract students? Do the private schools attract students by emphasizing on language or on the sciences? In raising questions such as these ones and trying to find out answers, one may be able to come up with the knowledge of the impact of the earlier thinking of curricula to the present school system we have today.

The introduction of the Western (modern) education, from the outset, did not please a number of people and was not welcomed by the Ethiopian Orthodox authorities and their followers and inflicted resistance to it. Hence, the attempt of bringing change through the traditional models to modern and secular form of education, however, was not a simple task for those who tried to change (Alemayehu & Lasser, 2012: 53). After a serious conflict with the church authorities and their followers, an agreement was reached in 1907 to employ teachers of the Coptic faith to teach in the new system of education.

Its objective was to provide education that would equip the students who could serve the state in different sectors of the economy and other service areas at different levels and capacities. The need for having more contact with the outside world also became one of the significant stimulants for education and encouraged the introduction and use of the schools as a means for the creation of high level interpreters and translators. In those early days, the content of the education provided within the schools focused mainly on communication skills and the essentials that were necessary to run the then new bureaucracy and the associated institutions.

For the first time in Ethiopian history, a director general of public education was appointed in 1929 and it was elevated to the status of Minister in 1930. At that point in time there was no physical system capable of supporting the systematic growth of educational services. The system remained dependent on personal funds in spite of a decree in 1930 allocating a 2% of tax revenue to education. However, the idea of centralization and control, in short, the formulation of an education system in its modern form began and continued slowly to take shape. Committees were organized to plan and shape the system to meet the growing needs of the community for education (year book, 1951-53). Up to 1945 it was a period of increasing the number of elementary schools. At that time parents also began to realize the importance of public education and students were no more asked to come to school as it were in the years before then (year book, 1951-53).

The first high school, the Hailesellasie I Secondary School, was formally inaugurated in 1943 and teachers who would teach at that level were provided by the British Council (Trudeau, 1968). During that time, there were many teachers teaching in the elementary schools and almost all of them were foreign teachers. Evidences reveal that there were no definite programs of studies in the education system at that time, but secondary schools were better unified because they were preparing students for the school-leaving certificate along the general lines of the London Matriculation (Trudeau, 1968). In 1952 there was a relatively strong network of the then existing four hundred elementary schools and three colleges.

In the years 1951 - 53 there were six secondary schools. The curriculum for this level was adopted by the Ministry of Education in the year 1951-52, and it became operational in all of the secondary schools. Entrance to the secondary schools was based on the elementary school leaving examination. The courses provided at the secondary level were primarily for academic preparation of youngsters for the London Matriculation, which was later changed to General Certificate of Education. Students who were successful in the London Matriculation or the General Certificate of Education either went abroad for higher education (in the earlier years) or continued at the University College of Addis Ababa, which was established in 1950. Seen in general, the education provided in the country from 1940s until the end of the 1960s, as observed by Tekeste (1996: 15) "could be described as an elitist system".

In 1955 there was a structured government school system that comprised three main divisions of elementary – covering grades one to eight, secondary – covering grades nine to twelve, and higher level. At about the same time thoughts of "Long – term Planning" (MoE, 1955) appeared in the Ethiopian education system accompanied with the establishment of the Long-Term Planning Committee that comprised four Ethiopians and seven foreigners. The committee was authorized to undertake a survey of the then existing system, the schemes of work and academic standards and to make recommendations for possible reorganization (The Long-Term Planning Committee, 1955 (1947 E.C.)). This committee was also authorized to call for written and personal reports from administrators, school directors, teachers, and others engaged in or concerned for Ethiopian education.

The Long-Term Planning Committee's first report, which was entitled "Basic Recommendations for the Reorganization and Development of Education in Ethiopia", was presented in 1954. In that report, the committee, proposed the idea of "Community Schools for Basic Education", with the assumption of achieving the "modest possible distribution of opportunity for learning". The community schools were thought to provide basic education in its four year program to every individual within the empire. Command of the Amharic language and other basic abilities were intended to be provided at the community school level. It was also thought that the education provided at that level would enable individuals to cope more efficiently with the problems of everyday living and they would also contribute towards the advancement of the community and the country. In addition to this, it was also envisaged that a certain portion of selected community school graduates would be admitted into the four-year middle school program and that upon the completion of the middle school program a further selection would be made for entrance to the different type of secondary or higher schools. Even though the committee then was aware (as it claimed in one of its reports) of the necessity of providing education beyond the community school level to every child, at the same time members of the committee were convinced that it would not be possible to provide education for all beyond the community school level and that selective procedure would have to be applied at each further stage of the school system. The committee's report, also added a recommendation for the immediate reorganization of the system by the designation of the first four grades as "Primary", and the next four grades, that is, grades five through eight, as "Middle Schools" and the system of selection had to be retained in those school systems at each level.

The Board of Education, to whom the report was presented, after having looked into it and proposed certain amendments, returned the report to the committee. The committee then readily accepted the amendments and included in the final version of the report. Finally the board informed the committee that it was prepared to accept in principle the revised recommendation. At the same time the committee was also informed and authorized to consider the details of the organization, curriculum, and staffing with a view of implementation. While the agenda and the view on the provision of primary and secondary education were predominantly on a restrictive and limiting position, and while it was still in a fluid state, paradoxically, the need for considering the establishment and development of higher education started to come into sight.

2.4.3. Higher Education

The provision and practice of modern higher education in Ethiopia is relatively young, compared to the actual beginning of western type modern education within the country. On top of the long existed traditional education and the then yet developing primary and secondary education, Ethiopia also introduced higher education and began teaching students at that level in 1950 (AAU, 2008; Amare, 2005). Though there were many Ethiopians who went abroad (Amare, 2005) before the year 1950 there was no evidence of any Ethiopian (at least to knowledge of this researcher) who actively and decisively played a significant and knowledge based contribution for the establishment and materialization of higher education system in Ethiopia.

Because of the felt need for higher education from the government side, the establishment of higher education was decided by the Ministry of Education of Ethiopia from the outset (Trudeau, 1964). As a response to the Emperor’s demand for a kind of policy he should follow in establishing the secondary and vocational sections of Tefari Mekonene School, Dr. Matte proposed for the establishment of higher education (Trudeau, 1964). Mattee suggested the development of a university that comprised Engineering (Civil, Mechanical, Mining), Agriculture, Science, Botany, Geology, Mineralogy and Geography. Mattee also suggested the opening of medical school in conjunction with that of the school of sciences. Hence, a committee on founding of higher education was set in 1949 and this committee, within the same year, recommended the creation of a four year liberal arts college leading to B.Sc. and B.A and comprising two faculties—the Faculty of Science and Faculty of Arts. On the bases of the recommendation, the college was established in 1950 and was named as Trinity College which later, after eight months, changed to Addis Ababa University College (AAUC). Matte was appointed as the founding president of the first higher education institution. The faculty of Science was considered as the most important and was made to offer courses in Agriculture, Mathematics, Physics, Chemistry, and Biology. On the other hand, the Faculty of Arts was made to offer courses in Administration, Education, and Social Sciences.

As there were no Ethiopians who were capable of teaching at that level and at that time, Jesuit teachers of various nationalities who were initially involved in the teaching of secondary students at Teferi Mekonnen School (now Entoto Technical and Vocational College), were appointed to teach in the newly established University College. The first classes of higher education were begun on December 11, 1950 and this marked the first landscape for the start of the Ethiopian higher education in Ethiopia.

Even though the distinction between them was not flagrantly supported with an in-depth and comprehensive study, the Ethiopian higher education system had gone through "three major changes" (Wuhibegezer, 2013: 45). The first of the changes, was "the phase of an elitist education system under the traditional monarchy", the second phase was the change that was imposed by the "military rule where ideological control penetrated into the education system" and the third one was the higher education system "under FDRE" (Wuhibegezer, 2013: 45) where expansion of higher education become too evident. These changes were mainly associated with government changes. It is true that these changes have been major externally proposed changes that influenced the higher education system in many ways. But these alone do not suffice to be the only measures for the changes in higher education. Of course, that is, what is better known than any other changes that might have taken place within the higher education institutions. If we push the quest a little further and ask questions like: is the present higher education significantly different from the elitist education that was phased out? The answer we may get could probably be one of discouragement.

2.4.3.1. The Curriculum of Higher Education

In the preceding part it has been pointed out that the Ethiopian higher education system was established in 1950 which means 65 years back. Mention has also been made that the higher education at the beginning was influenced by the North American concept of Liberal Arts College. The curricular content was a Liberal Arts type similar to that of Jesuit College of North America. Liberal Arts and Sciences as defined by the State Education Department/the University of the State of New York (2003) refers to “courses of a general or theoretical nature that are designed to develop judgment and understanding about human beings’ relationship to the social, cultural and natural facet of their total environment”. This may be regarded as a landmark for laying down one of the foundations that characterizes the Ethiopian higher education curriculum. As it has been indicated earlier in this study the Ethiopian higher education system has undergone three changes associated with government changes. Though these changes witness the changes in the education system in general, research in higher education seem to be limited and fail to address the detailed changes that might have taken in the perspectives and ideologies that shaped curriculum and curriculum development in the realm of higher education.

2.4.5. Engineering Education

The provision of engineering education had started and existed within the Ethiopian education system since the year 1953 and it was administered by the Ministry of Education of Ethiopia at the beginning, for some years (Faculty of Technology, (1979-80 G.C.; Addis Ababa University Golden Jubilee 1950-2000, Agenda). The first classes of engineering were started and continued in what was called engineering college which was situated within the compound of the Technical School of Addis Ababa up to the year 1965. The first two years of its beginning was devoted to provide a two year intermediate engineering studies which prepared students for the completion of a degree level study abroad. Soon after, in 1955 a four-year degree program was commenced and upon completion of the program the first B.Sc. degrees were awarded in civil and industrial engineering in 1958.

However, in 1959 industrial engineering was made to phase out, and on the other side, expansion took place by the inclusion of electrical and mechanical engineering on the then existing programs. The consolidation of the Building College, (which was formerly known as the Ethio-Swedish institute of Technology) in 1961 was another side of the expansion of engineering education in Ethiopia. The Ethio-Swedish Institute of Technology was established in 1955 and initially it used to have a Diploma program in Building Technology which continued until it was finally changed and upgraded in 1957 to four-year degree program. The duration of the study of the engineering programs was four years and prolonged to five years on the grounds of shortages in qualified staff and the inadequacy of laboratories. But later in 1978 it was again changed to four years. Although much was not known about how the content was selected, the specific structure of the curriculum and the details of the practices (at least to the knowledge of this researcher), efforts were also made to overhaul the curricula of all the programs. Along with the overhauling of all the programs, the five-year engineering programs were again changed to a four-year program and the three-year advanced diploma program of Building Technology to two-and-half years.

Moreover, the provision of engineering education was extended to the relatively new institutions such as Arba Minch Water Technology Institute, which was originally established in 1986 under Water Resource Commission, and which was later transferred to the Ministry of education, Jima University, Makalle University, Bahir Dar University, and Hawassa University.

Currently, engineering education is provided in a number of engineering education institutions and universities within Ethiopia guided by the ECBP reform initiatives that took place since the year 2005. The general goal of the ECBP was, “improving the competitiveness of local manufacturing and construction industries and creation of employment opportunities for Ethiopian youth and thereby improving the standard of living of the society" (Bayou et al. 2006: 18). The university specific goal which was regarded as one of the strategies of attaining the ECBP's general goal was "improving studies in technical and managerial fields including the studies and training of vocational school teachers" Bayou, et al 2006: 18). This was further detailed to include the following specific objectives.

- *Develop and implement proposals for re-organization of university structure in order to acquire more decentralized, effective and cost conscious administration;*
- *Prepare and implement professional profiles for Architecture, Construction management, Urban and Regional Planning, Civil Engineering, Chemical Engineers, Electrical and Computer Engineers, Mechanical Engineers and revise and implement graduate and post graduate programs.*
- *Conduct human resource development in line with new curriculum.*
- *Establish partnership between Ethiopian and foreign universities/departments for all kinds of cooperation.*
- *Establish and strengthen University-Industry linkage promotion.*
- *Prepare and implement infrastructure upgrading requirements of university facilities for selected universities/departments.*
- *Establish a system of E-learning and develop and implement a concept for IT-based library and build models.*
- *Develop and implement comprehensive practice oriented concept of TVET Teacher Studies and a demand-driven HRD scheme* (Bayou, et al. 2006, 18-19).

The specific goal of the ECBP's university reform was to acquire a practice and demand oriented higher education in the wider field of engineering disciplines that can actively and innovatively contribute and support the industrial development of Ethiopia. This model, as it is pointed out in Chapter one of this dissertation, is closely associated with human resource development that has to do with improving working systems that would help the industry and the manufacturing sectors within the country.

CHAPTER THREE

THE RESEARCH METHODOLOGY

3.1. Introduction

This study employed a qualitative case study methodology that involves three higher education institutions for the study of the curriculum development process of engineering education program and its practices within the higher education context. The chapter deals with the description and explanation of the research methodology and the design employed to undertake this particular study.

3.2. Qualitative Research Approach: A Choice for this Study

The focus in this study was on understanding of the new engineering curriculum development process and its practices from the perspectives of stakeholders within three purposely selected engineering education institutions in Ethiopia. Generally, researchers in engineering education appear to favor more of quantitative methods due to their training background, which resides within the post-positivist perspective (Borrego, Douglas, and Amelink, 2009: 53). However, qualitative research, in recent years, has gained more importance and used in engineering education research as engineering educators try to improve classrooms, programs, and institutions (Leydens, et.al., 2004: 65; Koro-Ljungberg & Douglas, 2008: 163; Case & Light, 2011: 188; Chism, et. al., 2008).

An "understanding of the engineering curriculum development process and its practices", in this particular study, refers to gaining a better insight into the processes and the decisions that are involved in the engineering curriculum development and its practices and it includes the strengths and/or weaknesses, and encounters of engineering curriculum development, and factors affecting positively or negatively in its development process and its practical implementations at each level, as seen from the perspectives of stakeholders, within the engineering education system in Ethiopia, with a particular reference of the three sites involved in the study.

Qualitative research approach is chosen as a methodology for this research for its power in an in-depth treatment of the research problem. Qualitative research is defined as "primarily an inductive process of organizing data into categories and identifying patterns (relationships among categories)" (McMillan and Schumacher, 1993: 479). Casewell (1998) sees qualitative research as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem". According to Casewell, such a research builds complex and holistic pictures, analyzes words, allows a detailed view of information, and it is conducted in a natural setting. Similarly, Dinzen & Lincoln (1994) express the power of qualitative research as follows:

> *Qualitative research is a situated activity that locates the observer in the world. It consists a set of interpretive material practices that make the world visible. These practices transform the world. They turn the world into a series of representation, including field notes, interviews, conversations, photographs, recordings, and memos to the self* (Denizen & Lincoln, 1994).

On the other hand, Strauss and Corbin (1998) define qualitative research in terms of its properties by saying:

> *By the term 'qualitative research' we mean any type of research that produces findings not arrived at by statistical procedures or other means of quantification. (Strauss and Corbin, 1998: in Ritchie and Lewis* (2003:3).

Therefore, this researcher believes that qualitative research is more suitable for an in-depth investigation of the answer for the research questions raised in this study and to attain the objectives set, by probing data from those who are directly or indirectly involved in the engineering curriculum development process and those who are currently experiencing it at institution level.

3.2.1. Why Multiple-case Study (Embedded) Design?

Qualitative study in general is an approach to research that facilitates exploration of phenomenon within its context using a variety of data sources. Yin (1994) defines case study as an empirical investigation into the contemporary phenomenon operating in a real-life context. It is argued that case study research is heterogeneous activity covering a range of research methods and techniques, a range of coverage, differing lengths and levels of involvement in organizational functioning and a range of different types of data (Hartley, 1994).

The focus of the study, that is, "engineering curriculum development process and its practices" is the main case of the study having different sub-cases within it. The different research sites into which the engineering curriculum is practiced are multiple cases entertaining the same case, that is, engineering curriculum development and its practice. Schramm (1971) points that "the essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result" (Schramm, 1971: cited in Yin, 1993: 12). Yin also posits that case studies in evaluation research have "at least five different applications" (Yin, 2003: 15). According to Yin, the first of these applications refers to explanation of the presumed causal links in real life interventions while the second aim is to describe an intervention in the real life context in which it occurs. The third applies to illustrate certain topics within an evaluation in descriptive mode; the fourth application is used to explore those situations in which the intervention being evaluated has no clear, simple set of outcomes; finally, the fifth type of application deals with a meta-evaluation—a study of an evaluation study.

Case study, in spite of its emphasis on the significance of knowledge generated in particular contexts (Case & Light, 2011), is also identified as one of the "emerging" methodologies in engineering education. The use of qualitative methods in engineering education, is recognized as a method that provides important insights which otherwise would have not been possible through quantitative approaches (Koro-Ljungberg & Douglas, 2008: 172). Rigorous qualitative case study permits researchers to have opportunities to explore or to describe phenomena in context using a variety of data sources. It allows the researcher to explore individuals or organizations (Baxter & Jack, 2008). The choice between a case study designs, however, falls between choosing a single-case design and multiple-case design (Yin, 2003). According to Yin, single-case designs are "justifiable under the following conditions" that is, when the case represents a) critical test of theory, b) rare circumstance, c) a typical case, d) revelatory or (e) longitudinal purpose.

On the other hand, the evidence from multiple cases is regarded as "compelling" and "robust" compared to that of the evidence from a single-case design. It also addresses the question related to the researches' "replication" purpose. A multiple case study enables the researcher to explore differences within and between cases. According to Yin (2003), case study designs can be single-case (holistic) designs (Type 1), single-case (embedded) designs (Type 2), multiple-case (holistic) designs (Type 3), and multiple-case (embedded) designs (Type 4) (Yin, 2003: 39).

Hence the case study design employed in this study is influenced by the multiple-case (embeded design) (Yin 2003). Engineering curriculum development process and its practices involves different tasks such as that of curriculum planning, implementation (teaching and learning), and student assessment. These are cases (embedded) within the main case study of the engineering curriculum development process. On the other hand, since the same research is conducted within three different sites by employing similar strategies of data collection and analysis, it can be labeled as a multiple case (embedded) design or as indicated by Yin (2003) Type 4 design. Yin points out that the evidence from multiple case studies is more compelling and the overall study is therefore regarded as being more robust.

The "two mainly known approaches", which guide case study methodology, are that of Stake (1995) and Yin (2003) (Baxter & Jack, 2008: 545). Baxter & Jack (2008) point out that both Stake and Yin base their approach to case study on a constructivist paradigm, which claims that truth is relative and that it is dependent on one's perspective. The constructivist paradigm "recognizes the importance of the subjective human creation of meaning, but doesn't reject outright some notion of objectivity" (Baxter & Jack 2008: 545).

Given that there is little or no empirical research in engineering curriculum development and its practices in the context of Ethiopia, the present research can be regarded as exploratory in its nature. Case studies help achieve this purpose by using a manageable sample to gain deep understanding of each case. Lastly, literature has suggested that the perception with regard to the concept of curriculum, curriculum development and its practices vary. Multi-case studies better capture the conceptual and practical variability of curriculum and the teaching learning experiences of teachers and students within the different sites than single case studies and “enhance the generalizability of the research findings” (Yin, 2009).

Stake (1995) categorizes case studies into two types: intrinsic and instrumental. An intrinsic case study focuses on learning from the case, and an instrumental case study focuses on learning about the issue, or research questions (Stake, 1995, p. 24). The current research also falls into the instrumental category which means that this researcher used the cases as instruments to understand the issue of engineering curriculum development process and its practices and how teachers and students experienced and made sense of their experiences.

3.2.2. Data Sources and Strategies of Data Collection

To serve as a guide, the present researcher has constructed the following framework and has used it as a guide to indicate the directions and the interrelationship of the different aspects or activities of the research undertaking which include the research questions, data collection methods, data organization/management, analysis of the data, and the findings of the study and their implications to engineering curriculum development and its practices. However, the figure does not show the details of what is included and what happened in each of the boxes. Those are described separately one by one in the subsequent parts.

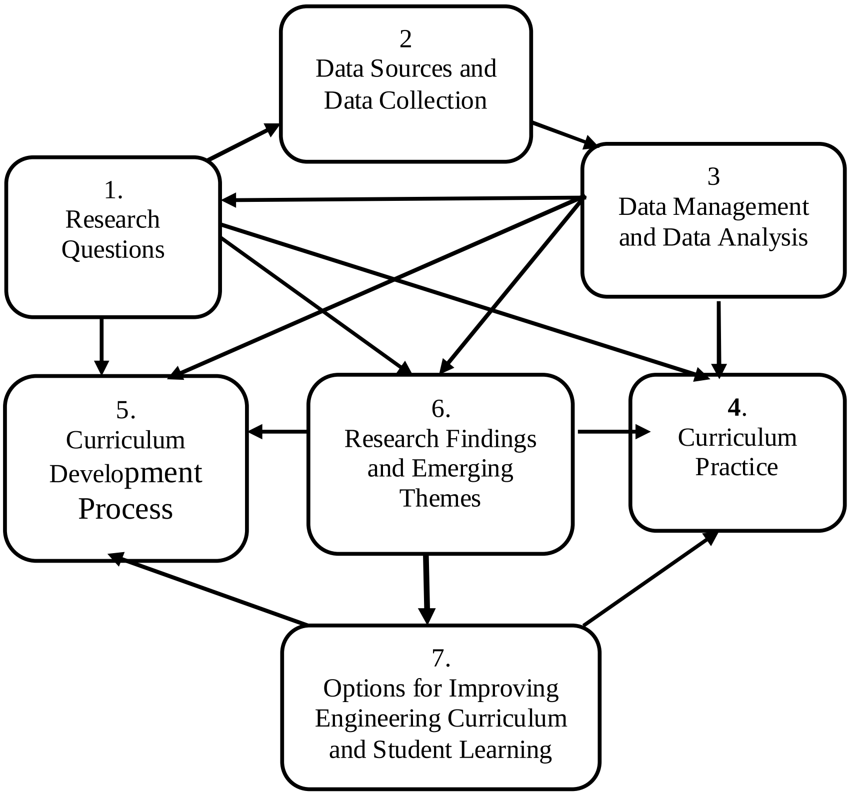


Figure 3. Data Collection and Processing Framework

The direction of the arrows, as can be seen above, indicate how the activities are interconnected. For instance, the arrows which start from the box that contains "research question" (Box 1) are directed towards Box 2 indicating that data sources and data collection techniques are made and used in reference to the research questions. The three arrows pointing to Boxes No. 4, 5, and 6 indicate that the research questions are about the understanding of the curriculum development process (Box 5) and its practices (Box 4) which, at that point, was expected to result in findings and emerging themes (Box 6). The arrow that begins from Box 2 and points to Box 3 indicates that the data collected from all sources can be managed and analyzed to answer all the research questions (box 1) with regard to the curriculum development process (Box 5) and its practices (Box 4) and finally to the research findings and the emerging themes (Box 6). The two arrows that begin from Box 6, pointing horizontally to Boxes 4 and 5 show that the findings and the emerging themes mainly speak about the engineering curriculum development process (Box 5) and its practices (Box 4). The arrow that starts from Box 6 and points towards

Box 7 shows the contribution of the findings and the ideas of the emerging themes to the conclusions, suggestions and/or recommendations.

3.3. Procedures for Selecting the sites and Participants for the Study

The initial phase of data collection involved the decision about which sites to select and whom to involve in the interview and/or in focus group discussions. This was a very crucial stage of determining whose ideas, perceptions, experiences, and attitudes will be most important to answer the research questions and to achieve the research objectives. Finally, the decision was made as per the criteria described below.

3.3.1. Site Selection

The three higher education engineering institutions, namely, Addis Ababa Institute of Technology (AAIT), the School of Engineering (SoE) at Adama Science and Technology University (ASTU), and Bahir Dar Institute of Technology (BIT), were deliberately selected as sites for the study on the anticipation of availability of sufficient number and appropriate participants for the study within these institutions. Though the three institutions share some common culture of higher education at present, they are also different in some respects. It is generally believed that each school has its own unique culture (Altrichter & Elliott, 2000), and specific cultures are molded by the shared experiences of participants. The three purposely selected sites are more or less, similar in their current official mandate since they all are obliged to enforce their activities on the basis of the education policy (1994) and on the higher education proclamation 650/2009. Even though they are different in their previous experiences of providing engineering education, at present they all stick to using the reformed engineering education curriculum which was developed under the auspices of the former ECBP and are expected to make progress in that provision. Nevertheless, they are different in their geographic location, historical background, experiences in providing engineering education, the number and the level of qualification of their teaching staff, and the physical and other resources under their disposal.

For instance, the SoE at Adama University and BIT, are somewhat younger in terms of the length of the time they have existed as engineering education institutions and in terms of their experiences in providing engineering education. On the other hand, AAIT has a rich and long experience of providing engineering education which extends back to the late 1950s. However, at present they all are involved in providing the undergraduate engineering courses in different fields of studies based on the ideas of the reformed engineering education framework, which was initiated by the Engineering Capacity Building Program (ECBP). To obtain reliable data regarding the topic under study and to have a better understanding of it, it was necessary to involve purposely selected participants from each of the selected sites. Initially, it was planned to collect data from four sites including Makelle Institute of Technology. Due to some time and resource constraints, data collection and site visits were limited to the three engineering institutions, that is, SoE of ASTU, AAIT, and BIT.

3.3.2. Selection of Individual and Group Participants

Although there are many actors in engineering curriculum development process and its practices, given the aim of the research, capturing the ideas of all stakeholders was beyond the scope of this research. Since no one is equal with teachers and students in terms of propinquity to the engineering curriculum, curriculum development process and its practices, primary focus was given to engineering teachers and students to serve as crucial participants of this research.

Teachers are the ones who implement the curriculum and students are the ones who are expected to be affected by the curriculum to result in the desired outcomes. Hence, teachers and students who were purposely drawn from the three sites of higher education/engineering institutions were made to be involved in the interviews and focus group discussions. However, data were also collected from purposely selected representatives of industry and key informants from the Ministry of Education (MoE), for their previous and present knowledge, acquaintance and proximity to the subject being studied.

The details of the sample selected are as follows: Selected teachers, who are teaching Mechanical, Civil, and Electrical Engineering courses in all the three institutions are included as participants in this study. Focus on teachers of these engineering areas was made because they existed as separate fields of studies within the engineering education system and are available within the three institutions selected for this study. Two teachers of each of the fields of studies who are believed to have better experience and ability of sharing their lived experiences in the engineering curriculum development process and in implementing the reformed curriculum were selected using purposive sampling method along with snowball sampling method.

Access to the participants was made through the deans of the respective institutions upon delivering a letter from College of Education and Behavioral Sciences particularly the Department of Curriculum and Teachers Professional Development, Addis Ababa University (see Appendix). Deans and department heads were also the participants of this research because of their proximity to the curriculum development process and their involvement in its practices within their respective institutions both in teaching and leading. They provided their perceptions and views during the interview sessions particularly planned for them and held in their respective offices.

Secondly, with the aim of triangulating the data obtained from teachers and other sources with that of the views of students, data were collected from purposely selected students of each of the three sites. A minimum of six student participants who were learning in their third, fourth, and fifth year of the different fields of engineering were purposely selected and were requested to participate in a focus group discussion set by this researcher in their respective institutions. They were selected from Mechanical, Civil, and Electrical fields of studies. These students were assumed to have been more acquainted with the curriculum, know what is happening in the teaching learning and assessment process, and they are more mature and experienced in the campus life in which they were learning.

Table 3. Composition of the Research Participants

Participants	Adama	AAiT	BiT	MoE	Industry	Total
MoE Experts	-	-	-	2	-	2
Deans	1	1	1	-		3
Head of Depts.	3	2	3	-	-	7
Teachers	6	6	5	-	-	17
Students	6	6	6	-	-	18
Industry key informants	-	-	-		4	4
Total	15	15	15	2	4	51

3.3.3. Procedure and Strategies of Data Collection

Data pertaining to the research questions and objectives were collected from different sources using different data collecting strategies. Primary data were collected using semi-structured interviews (see Appendix B) in the form of guided conversation and focus group discussion. Secondary data were obtained from written and recorded documents that included policy materials, curricular documents, examination papers, brochures, catalogues, agendas, and minutes of meetings.

3.3.3.1. Preparation for Data Collection

For conducting the research within the selected higher education institutions, primarily, a letter of request was secured from Addis Ababa University, College of Education, particularly from the Department of Curriculum and Teacher Education (see Appendix 1). At the initial stage of the contact with personnel in the research sites, a copy of the letter was delivered to Academic Vice President of one of the research sites, a scientific director of the second site, and to a deputy scientific director of the third site. Likewise, in the case of the first contact of three purposely selected industries, the same copy of the letter was delivered to the appropriate offices (e.g., public relation office, human resource development office) of each of the industries. Three industries, which the researcher thought that they are the most significant employers/consumers of engineers, were contacted with the anticipation of interviewing a key informant in each of the industries. From here the letter was forwarded to the persons who were considered to be knowledgeable on the subject of the study by the officer in charge (see, for example Appendix B). Vice president and directors of the academic institutions were contacted at the initial stage of data collection within the sites because they are the highest administrative officials responsible for the academic matters within those institutions.

After the researcher introduced himself and explained why he was there and what he needed, the officials signed and forwarded the same letter that carried a short memo, their signature, the names of the deans with whom the researcher should contact and the institution's stamp on it to the deans (see Appendix C). A photocopy of the signed letter was again delivered to each of the deans. As the researcher delivered the letters to the respective deans, he also introduced himself and briefly explained about the title and purpose of his research and he ultimately told to each of them that he needed to conduct interview with them, with teachers and focus group discussion with students. All of the deans, except one, whom the researcher contacted, were willing to be interviewed. Table 3 shows that one dean for each of the institution that included a vise dean whom this researcher substituted in place of the dean who declined.

Selection of the appropriate teacher and student participants was began and continued with the advice of the deans. In some cases they identified for the researcher the appropriate person whom they thought knowledgeable on engineering curriculum development and who had more experience in practicing it. In other cases they directed the researcher to the department heads for carrying on the selection of the participants. The department heads, as the deans did, also identified the names of more candidates for the interview. Having secured the names of the possible "would be" candidate interviewee (teachers), the researcher went to each teacher's offices to ask for their permission and willingness for the interview. Many of them responded positively to his request, soon after he introduced himself and he briefly explained the title and the purpose of his research to them. Only one declined the researcher's request on the grounds of being busy and not having enough time for the interview.

Selection of focus group discussants (students) were also conducted by negotiating with the deans and heads of the respective departments. They provided the names of the group representatives of the students learning at each level of each of the departments. While some of the representatives they themselves opted to participate in the group discussion others pointed out and picked whom they thought have better knowledge of the subject under study.

The interviews and the focus group discussions were conducted from the beginning of January to the first week of July, 2014. During each of the interview sessions, each participant was informed that the interview would be carried on voluntary bases and that they have the right to withdraw if they do not want to continue with the interview. They were also asked their permission for recording their voices which most of them accepted, except few. Finally, at the end of interview sessions, each of the participants were requested to sign on the consent form (see Appendix D) prepared by this researcher.

3.3.3.2. Strategies for Data Collection

Three different types of data collecting strategies were used in this study, that is, semi-structured interview, group discussion, and document analysis of various type and nature. These are described below.

3.3.3.2.1. Semi-structured Interview

Qualitative interview is one of the important techniques in qualitative research of all kinds (Myers & Newman, 2007). Interviewing, as one of the qualitative research technique, involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation (Boyce & Neale, 2006: 3). Moreover, the "qualitative research interview probes human existence in detail. It gives access to subjective experiences and allows researchers to describe intimate aspects of people's life worlds" (Brinkmann & Kvale, 2005: 157).

In this research semi-structured interviews, which are sometimes referred to as "focused interviews" (Beverley, 1998), are used as one of the primary data collecting strategy to collect data from purposely selected engineering teachers and key informants from the industry and MoE. Each of the interview sessions took a minimum of 45 minutes to one hour depending on the availability of time for the interviewee and the quantity and the depth of the information provided and the views expressed by the interviewee.

Semi-structured interview as a data collecting device allowed this researcher to collect data from the specific, purposely selected participants and to obtain their perceptions and views (Chism, et al. 2008) on the topic. The semi-structured interview used in this study was not rigidly structured and, therefore permitted the interviewer to encourage the interviewees to talk at length about the topic of interest. It allowed the informants to focus on the questions and to explain the reasons underlying the problem and/or the practice in the target group and ultimately helped the researcher to elicit rich, detailed data that could be used in the analysis (Lofland and Lofland, 1995).

Interviews are regarded as the "most important sources of case study information" (Yin, 2003: 89). Data were also collected using a semi-structured interview from the purposely selected participants of the industry and MoE to capture their perceptions of engineering curriculum development process and its practices, their observations of the performance of engineering graduates, and their views of their own participation in the process and practice of engineering curriculum development process and its practices.

Since the interview questions were prepared in English and directed to teachers and students of higher education, conversation took place in English with many of the participant teachers, except in few cases where Amharic language was used based on the choices of the participants themselves. Questions for the interview were related to the four research questions indicated in Chapter One (See Appendix B). For each of the research questions two to four questions (including the probing questions) were presented to the participants. The responses provided by most of the participants were recorded by tape recorders in some cases and by an electronic voice recorder in others. For those who did not want their voices to be recorded (one teacher in ASTU and two teachers of AAiT), the researcher used field notes for recording their responses.

3.3.3.2.2. Focus Group Discussions

In focus group discussion, participants were requested to present their own views and experience, but also hear from other people (Ritchie & Lewis, 2003: 171). Participation in the discussion was on voluntary bases. The researcher informed the participants (before and during the discussion) what the aim of the research is and that there is nothing to fear to talk whatever they want to talk as long as it is related to the discussion points posed by the researcher. They were also informed that their names will not be disclosed and anonymity or pseudonyms may be used in reporting the research results. It is believed that a focus group "presents a more natural environment than that of the individual interview because participants are influencing and influenced by others – just as they are in real life" (Kreuger and Casey, 2000: cited in Ritchie & Lewis, 2003: 171). Focus Group, in general, involves six to eight people who meet once for a period of around an hour and a half or two hours.

The Focus group strategy employed in this study involved purposely selected 3rd, 4th, and 5th year students of Mechanical, Civil, and Electrical engineering within each of the selected institutions. The number of participants involved in the focus group discussions within each of the institutions was at most six students. The time taken for each of the discussion sessions ranged from 1 hour and 45 minutes to 2 hours and ten minutes. The language of communication in the focus group discussions held in each of the sites was Amharic because of the participants' decision that Amaharic language would enable them to express their ideas and views better than the English language within the group. This strategy (that is, the focus group discussion) was so important in capturing data pertaining to the views of the students with regard to their understanding of the engineering curriculum and what was actually happening in the process of teaching/learning including the process of assessment and the problems associated with it, within their respective campus classrooms and/or workshops, and with regard to their relations with their teachers and their practice of internship within industries.

3.3.3.2.3. Document Analysis

Additional data necessary for the study was also collected from print and other recoded documentary sources which included curricular documents, books, agendas, and minutes of meetings, course catalogues, framework directives, yearbooks, and other pertinent materials. Such documents were of great value to the researcher in examining the perspectives, contexts, directions, and purposes of education and curriculum development in general and of engineering education and curriculum development process and its practices in particular. Context specific materials such as the Ethiopian Education and Training Policy (ETP), the Growth and Transformation Plan (GTP), Education Sector Development Plans (ESDP), proclamations, and many other documents of such type have provided the general and particular contextual information for this study. Engineering curricula frameworks, curriculum guides and other related documents have also provided information about the intentions, mission, aspirations and contents of the engineering education practice. It is asserted that “For case studies, the most important use of documents is to corroborate and augment evidence from other sources” (Yin, 2003:87).

3.3.3.2.4. Pilot Testing

It is pointed out that a pilot study in qualitative research is necessary in order to determine whether there are flaws, limitations, or if there are weaknesses within the interview design, and if it is necessary to make the necessary revisions prior to the implementation of the study (Kvale, 2007, In: Turner, 2010). Robert Yin also asserts that a “pilot case study will help” to “refine …data collection plans with respect to both the content of the data and the procedures to be followed” (Yin, 2003: 79). In another words, a pilot study, in general, is believed to have the "potential benefits in putting a toe or two in the research waters before diving in" (Sampson, 2004: 399).

Hence, a pilot case study was conducted in one of the similar engineering education sites with teacher and student participants who have similar interests as the participants for the main study. The pilot study involved conducting interviews with selected teachers and a focus group discussion set by this researcher. The main criteria in selecting the site for the pilot case study and the participants from within the site were convenience, access, and geographic proximity. Conducting the pilot study has helped the present researcher in checking the relevance and capability of the interview questions to generate answers for the main research questions, in achieving the objectives of the study and in gaining the techniques of interviewing and conducting focus group discussion that were intended to be employed in the main research process.

Equipped with this experience and the data collected from the pilot study the researcher was able to have some modifications on the interview questions, which he found not clear or cumbersome to understand for the interviewees. Based on this feedback from the pilot study, the necessary corrections and adjustments were made for the subsequent conduct of the interviews and focus group discussions that were employed in the main research process.

3.4. Data Analysis Procedure

Since analysis of data in qualitative research requires an iterative approach and interim analysis (Creswell, 1998; Plays, 1997; Silverman, 2000), data analysis, in this study began at "the start of the research study" (Ritchie & Lewis, 2003: 199) and it continued as inherent and ongoing part of the research throughout the process of data analysis. It was performed all the way through; beginning to end, by organizing the field notes, transcribing the tape/electronic recorded interview responses and the focus group discussion results and writing up the results. However, to analyze the data obtained from the interviews and from focus group discussants, the researcher had been influenced by the approaches of both (Ritchie & Lewis, 2003) and (Yin, 2003) and had made use of both approaches in the data analysis. In the sense of Ritchie and Lewis (2003), analysis is targeted towards answering questions about “the contexts for social policies and their programs and the effectiveness of their delivery and impact”. According to Yin (2003), there are three general analytic strategies, i.e., “relying on the theoretical propositions”, “rival explanations”, and “case descriptions” (Yin, 2003: 209). This researcher used the theoretical propositions especially when doing the cross-case analysis.

3.4.1. Transcription

Primary data were originally collected using audio tape recorders and in some cases using electronic voice recorder. Where this was not possible, the researcher handled the responses of the interviewee, primarily in the form of hand written field notes which were later organized in appropriate format. All data recorded on either the audio tape recorder or on the electronic recorder, together with the data collected using field notes were transcribed, typed on a word processor, and are made available in print format with a wider margin in the right-hand side. Since some of the interview responses were in Amharic, they were also translated into English and are made part of the data. Translation was made primarily by the researcher, but for checking its reliability and plausibility of the language usage, part of it was forwarded to an English language expert and checked.

The process of transcribing the data was one of the significant parts of the analysis since it gave to the researcher the opportunity to be familiar with the data and to make some significant notes. Finally, transcripts were checked for errors by listening back to the audio-recordings and reading the transcripts simultaneously. The researcher read and re-read each transcript, and listened back to the audio recorded interviews to become more familiar with the whole data set.

The familiarization process was essential, especially for recording initial impressions in the margins of transcripts, for example where participants expressed exceptionally strong or contrasting views. Interesting or important segments of the text are underlined and the right hand margin was used to describe the content of each paragraph with a label. The same margin was used to describe more detailed notes and ideas, for example questions to bear in mind as the analysis proceeded, and ideas for explanations or patterns in the data. For conducting the analysis of the data in this research, the background information, the four research questions which are indicated in Chapter One of this dissertation together with the perspectives related to education, curriculum and curriculum development process and practice in general, and engineering education, curriculum development process and practice in particular (Chapter Two) provided the theoretical propositions/themes.

3.4.2. Credibility and Trustworthiness

In the conventional positivist approach, terms such as validity, reliability, and objectivity are criteria used to evaluate the quality of research (Payton, 1979). Since the interpretive method differs from the positivist tradition in its fundamental assumptions, research purposes, and inference processes, using the same criteria for judging qualitative research results is unsuitable (Bradley, 1993). Recognizing this gap Lincoln and Guba (1985) posit that credibility, dependability, conformability, and transferability, as the main criteria for evaluating interpretive research work.

For ensuring the credibility of the research, the researcher devoted ample time within the work vicinity, that is, within the institutions in which the research participants were working. This provided the researcher a chance to obtain more clarification and to understand their views and responses in depth. In most cases, a qualitative researcher is regarded as part of the research (Aamodt, 1982) and not separate from it and such an engagement allows him/her to check the perspectives of the informants which, at the same time, helps the participants to become accustomed to the researcher (Kielhofner, 1982). Moreover, the researcher tried to understand the data clearly through repeated reading and finally reduced it to simplify its complexity by extracting recurring themes.

In some instances, the transcribed interview texts were given to the interviewees for member checking to see if the data make sense. This is believed to decrease the chances of misrepresentation (Lincoln & Guba, 1985). In one of the research sites two draft copies of the report regarding the particular site were also given to two participants to see and comment on the actual report. The feedback from them was also incorporated where necessary.

To further enhance the credibility of the research, evidences from interviews, and focus group discussion including the information secured from document analysis are triangulated and checked against each other to minimize distortion that might arise from using a single data source. Triangulating data from the different sources enabled the researcher to see the consistency of responses and the converging or diverging nature of the ideas or responses. Triangulation is believed to be a powerful strategy for enhancing the quality of a research, particularly its credibility (Krefting, 1991) and it is based on the idea of convergence of multiple perspectives for mutual confirmation of data to ensure that all aspects of phenomenon have been investigated (Knafl & Breitmaye, 1989, In: Krifting, 1991). In addition to this, with the intention of receiving feedback that would help to improve the inquiry findings, the research as a whole and the findings were presented to the curriculum and instruction teaching staff of ASTU into which the researcher is a member. Finally, the draft copies of the research were given to two readers for their feedbacks and suggestions with regard to the whole nature of the study and the methodology used. All of these were further incorporated as supportive feedback to correct some of the errors and pitfalls of the study. As mentioned earlier in this chapter, data for the study were collected using different strategies, that is, semi-structured interviews and focus group discussion mainly. These were made available in print and electronic forms for anyone who would like to corroborate the data.

3.4.3. Issues of Responsibility and Ethics with Regard to the Participants of the Study

Realizing that interviews including focus group discussions have an ethical dimension and that it is concerned with interpersonal interaction and produce information about the human condition, this researcher has established a consent form (Appendix A and Appendix G) which the participants of the interview and the researcher had to sign on, after reading it thoroughly and reaching agreement. The form included the purpose of the research, the problem that was addressed, the methods used to gather the data, and the groups who would be involved in the study.

Participants, particularly those involved in the interviews, were also briefed what was expected of them and that it was only when they agree that they would give their consent, that they have the right to refuse to participate and that they could withdraw without penalty even after the beginning of the research. It was also made clear that anonymity of persons and/or confidentiality of their data is protected if appropriate.

Similarly, participant students were communicated orally about the ideas of the research and its aims and their participation in the group discussion is on volunteer bases. They were also informed that they can withdraw at any time if they don't want to participate. Communication of this matter took place not only once in groups but also individually during their invitation to the focus group discussion.

CHAPTER FOUR
PRESENTATION OF EMPIRICAL RESULTS

4.1. Introduction

The empirical results for the case study of the "new engineering curriculum development process and its practices in Ethiopia" are organized and presented in chapters 5, 6, and 7 separately; representing each of the three sites within which the study is performed and within which the new engineering curriculum is implemented. The cross-site results are presented under Chapter 8. Since the same semi-structured interview questions, focus group discussion questions, and related document analysis of each of the sites, were used as tools for data collection from each of the three sites, the same thematic topics and sub-topics are identified and used to present the empirical data for each of the three sites under each of the chapters.

The empirical results presented in each of the chapters are obtained from the analysis of the data pertaining to the interviews of the engineering teachers, deans, department heads, and from selected industry personnel including the focus group discussion of engineering students in each of the three sites. The data were analyzed following the procedure discussed in chapter three and were sorted and grouped into various categories and themes. At the end of the categorization process, twenty major categories were identified each with its own sub categories except the first one indicated on the following list of themes. Furthermore, these categories were collated under seven thematic areas for presenting the results in a coherent and systematic way under each of the chapters. The main thematic areas are:

- Initiation for Change of Engineering Education and Curriculum
- The institution as a Context of Engineering Curriculum Implementation
- The Engineering Curriculum Development Process.
- The Content of Engineering Education

- Teachers' and Students' Perceptions of Engineering Curriculum.
- The Interface Between Engineering Curriculum Expectations and Engineering Education Practice (Implementation)
- Challenges of Engineering Curriculum Implementation.

The following Table shows the seven thematic areas and the twenty categories obtained using the Framework analysis procedure. There is not a one-to-one correspondence between the thematic areas and the research questions at this level. Accordingly the empirical results for each of the themes are presented in chapters 4, 5, and 6. The cross site analysis is presented in Chapter 7.

Table 4. Themes of Analysis

Themes	Categories
• Initiation for Change of Engineering Education and Curriculum	
• The Institution as a Context of Engineering Curriculum Implementation	• Geographic location • Experiences prior the engineering curriculum reform • Engineering curriculum reform
• The Engineering Curriculum Development process	• Policy initiatives • Curriculum development within the institution • Teachers' participation in curriculum Development
• The Content of Engineering Curriculum	• Professional and personal attributes • Expectations of curricula • Knowledge and skill base • Content as a means of achieving the country's objectives
• Perceptions of the field of Engineering and Engineering Curriculum.	• A plan for student learning • A Means for fulfilling a country's objectives. • A Means for creating Engineers who are critical Thinkers and who are capable of doing things by themselves
• The interface between curriculum expectations and engineering education practice (Implementation)	• Teaching and Learning • Apprenticeship • Assessment
• Challenges of Engineering Curriculum Implementation	• Curriculum Revision • Teacher Quantity and Quality • Student Population • Budget and Resources

4.2. Initiation for Change of Engineering Education and Curriculum

Though not always, the ideas of recent reform activities, in Ethiopia, in many of the social and economic sectors by and large emanate from the Government's provision of proclamation No. 256/2001 "Proclamation to provide for the Reorganization of the Executive Organs of the Federal Democratic Republic of Ethiopia" (FDRE, 2001).

As far as this research is concerned, a significant component of that proclamation was the provision in the reorganization of a number of different Ministries and commissions, including the Ministry of Education, under the coordinating responsibility of the "Office for the Coordination of Capacity Building" (OCCB) (Proclamation 256/2001, Article 5, sub-article 1). According to this provision, the Ministry of Education was accountable to the Office. The Office, which was sometimes referred to as the Ministry of Capacity Building, was authorized with the powers and duties to: (1) initiate national capacity building policies; (2) ensure that the necessary capacity is created for the national capacity building; 3) supervise and coordinate the executive organs[2] identified (4) support regions in promoting capacity building activities; and (5) perform other activities necessary for the enhancement of capacity building. In other words the reform in higher education also had its roots in the "Sustainable Development and Poverty Reduction Program" of Ethiopia (PASDEP) (MoFED, 2002) which was an extremely wide ranging and ambitious program.

The objective of higher education as indicated in this document is to "Produce medium- and high-level trained manpower resources in sufficient quantity and quality for poverty reduction and sustained growth" (MoFED, 2002: 191). According to the provision of responsibility for implementation programs in this document, policy measures that concern the building of capacity in the private and public sector including the preparation

---

[2]Ministry of Education; Ethiopian Science and Technology Commission; Federal Civil Service Commission; Ethiopian Management Institute; Ethiopian Civil Service College; Justice and Legal System Research Institute were the executive organs that were accountable to the Office for the Coordination of Capacity Building.

of program for the development higher education was the mandate of the Ministry of Capacity Building (MoFED, 2002: 177)

Documents reveal that the launching of the initiative for the reform of engineering education which took place in 2005 was attributed to the leadership of the Ministry of Capacity Building (MoCB) (Waidmaier-Pfister, et.al, 2008) and with the financial and technical cooperation of Germany (Ethio-German, Negotiation, 2005) through the regulation of the Engineering Capacity Building Program (ECBP). The motto carried out by the time of the reform was “Building Ethiopia” signifying the overall reform of higher education and training and capacity building that was aimed at “creating country wide sustainable human resource capacity that is responsive to changing circumstances” (MoE, 2002: 3). Hence the reform in engineering education was more of responding to the need of industry which was fueled by the government’s idea of “accelerating industrial development in Ethiopia” (Knoop, n.d). The main aim was to support the private sectors through supporting the institutions that support them, among which the university program was taken as one pillar (pillar No. iv) within the ECBP. The university reform component of ECBP was then intended to support the transformation of higher education, which in this case means engineering education, to deliver most needed human capital for the labor market. The objectives with regard to this were stated as the following:

- *Development and governance of efficient institutes that work at the intersection between higher education and economy*
- *Implementation of engineering study programs based on international standards;*
- *Integration of technology transfer approach to provide solutions to industry.* (Knoop, n. d.)

In line with these objectives, some engineering Faculties such as that of the Faculty of Technology of the Addis Ababa University and Bahir Dar University, including others were changed into Institutes of Technology (IoT). IoTs, as pointed out by the Engineering Capacity Building Program Component 1: University Reform (2009), are centers for excellence in teaching practice-oriented applied technology education in which its graduates develop the required skills by way of industrial apprenticeship.

Hence, curricula for the various engineering fields of studies were developed and implementation was begun in Academic Year 2006/2007 in some of the IoTs, at least in the pilot form. Program provision also continued in the subsequent years within the rest of the IoTs and engineering faculties.

4.3. ADDIS ABABA INSTITUTE OF TECHNOLOGY (AAiT)

4.3.1. Introduction

This chapter deals with the first case, Addis Ababa Institute of Technology (AAiT) as part of the overall case study of the curriculum development process of engineering education program in Ethiopia. The seven themes and the respective categories indicated here in above are used as the bases for the presentation of the empirical results, in the Chapter.

4.3.2. The Institute as a Context of Curriculum Implementation

The sub-topics presented in this part include location, programs, and student population, experiences of AAiT prior to the engineering curriculum reform, and engineering curriculum reform.

4.3.2.1. Location, Programs and Student Population

The present AAiT campus, until recently, was a part of the long existed and well recognized Faculty of Technology under the jurisdiction of Addis Ababa University. It received its present status of an institute and name change to Addis Ababa Institute of Technology (AAIT) in 2010 (AAU, 2011; Kim, 2013: 115). At present, AAiT is one of the autonomous “teaching institutions” of Addis Ababa University (AAU, 2012: 25) which is “led by a Scientific Director with the rank of University Vice president” (Asres, n.d.). Many people, within the institute itself and outside it, regard that AAiT is one of the leading Institutes of Technology (IoTs). As pointed out by ECBP (2009: 20) an IoT is a part of a university with a special autonomous status. The vision statement of the institute also indicate that the Institute of Technology (IoT) is believed to be a home for technology and engineering that is focused on educating professionals and providing university-level knowledge to serve Ethiopia's needs (ECBP, 2009: 9). One of the IoT's mission statements, among others, is "to serve as a model for other educational institutions within the country and provide them with the necessary technological education and advanced training" (ECBP, 2009: 9). Some of the participant teachers in AAiT are even more confident to tell that AAiT is a leading and a model institute for other universities. The following is just one example of such a belief.

> As *you know we are considered as leading institute for other universities. …so we are the model for other universities, regarding curricula and laboratory set-up. Even our senior and young staffs have been participating to teach engineering students in other universities* (N. 16: p. 301).

As pointed out by the participant in above, it is obvious that most of the higher education institutions established recently and who are running engineering program seek direct or indirect advice (in most cases academic and in some cases administrative) and help of this senior and the most experienced institute. Since many of the senior engineering teachers are found in AAiT it is also true that these staff could help the other institutions in the engineering teaching learning processes.

The present AAiT campus, for many years in the past, as part of the Faculty of Technology, was identified as the Northern Campus. It has been housed in its present location (Amist Killo) and in its present building since the year 1969. At present, AAiT, is structured with four schools of Electrical and Computer Engineering, Mechanical and Industrial Engineering, Chemical and Bio Engineering and Civil and Environmental Engineering. AAiT caters a total student body of 9122 among whom 6916 are undergraduate students, 1322 postgraduate Master's students and 65 PhD students (AAU, 2013: 117) in all engineering programs.

AAiT in its educational provision conducts four undergraduate programs which include Electrical and Computer Engineering, Mechanical and Industrial Engineering, Chemical and Bio Engineering and Civil and Environmental Engineering with ten different areas of specialization. In addition to the undergraduate programs and areas of specialization, the institute in general, provides 33 postgraduate programs with many students enrolled in it. It is also characterized by its three Centers of Excellence related to water, energy and logistics.

4.3.2.2. Experience prior to the Engineering Curriculum Reform: Addis Ababa University Faculty of Technology

The history of engineering education in Ethiopia goes back to 1953. Even though it was began and administered by the Ministry of Education" (Demis, Alem, Daniel, and Edessa, 2006: 9) as the Imperial College of Engineering (RESR, 1973), for a while, a significant bulk of its development and history refers to the Faculty of technology of the Addis Ababa University from which the present AAiT emerged.

The Faculty of Technology used to have two campuses "each with distinct beginning of its own" (Bayou, et al. 2006) until recently. Before it grew to the faculty level, as a college, it offered courses of two-year program of intermediate engineering as a stepping stone for the students to subsequently continue their further study abroad at Bachelor of Science (B.Sc.) level (RESR, 1973; Bayou et.al, 2006). But two years later a four year program was introduced in civil and industrial engineering on top of the two-year pre-engineering education. The first graduation of engineers, in the history of Ethiopia, at degree level took place in July 17, 1958 (MI, 1960). But, later instruction in Industrial Engineering was phased out and the college was expanded to include instructions in Mechanical and Electrical Engineering.

In 1963-64 the curriculum was revisited with the assistance of groups from Israel and changes in some core areas of engineering were made (AAiT, n.d) in such a way that it suits the demands of some of the then growing industries of the Ethiopian Electric Power and Light Authority (EELPA) and the Ethiopian Telecommunications Authority (ETA), respectively (AAiT, n.d). The curriculum was reviewed again in the 1968-1969 academic year, when the University undertook a complete overhauling of programs of studies in all of its colleges and faculties to consolidate and streamline programs of study. During the 1968-1969 curriculum review separate task forces were set to work on updating and streamlining of the different programs and courses that include social sciences and the natural sciences. The natural science was divided into life science and physical science courses. Courses in the physical sciences were again divided into physics, mathematics, geology, and engineering disciplines. At this time of history the undergraduate engineering program and the courses covered within it were made to last in five years (Demis, et al. 2006). Later, in the 1970th when the University's name was changed from Haile Selassie I University to Addis Ababa University, the programs of the undergraduate engineering education were cut down to four years (Demis, et al. 2006). But, it was restored again to the original five year program after sometimes, that is, after four cycles of graduation.

4.3.2.3. The Engineering Curriculum Reform in AAiT

Though engineering education and engineering curricula, compared to other universities, were not new phenomena for the teaching staff of the Faculty of Technology at Addis Ababa University, the idea of the recent reform of engineering education did not emanate from within the institution. It was an idea that was brought by the then Ministry of Capacity Building (MoCB) to Addis Ababa University through ECBP. Though they ended up to be active participants in the reform process, either the institute or the teachers within it were not the initiators of the reform. Upon the quest made to know and to understand the degree of the involvement of the Faculty of Technology at the initial stage of the reform, one participant of this study indicated the following:

> *Actually I don't know any study that the university had made. It (referring to the idea of the reform) all came from the ECBP, and there was a strong position that there was a need for the reform of engineering program. And the universities were required to make the reform. In fact, as I learned from the Ministry, the Addis Ababa University was asked to take the lead in the reform and to do it by itself at the institution level. But the university at that time did not opt for doing it on its own* (N. 20: p.370).

What can be seen here is that the idea of reforming engineering education was not from within the educational institute; neither by teachers nor by the leaders of the institute. As pointed out by the participant of the study, the idea of the reform came directly from the ECBP and the university allowed the Faculty of Technology to be involved in the reform activity with ECBP. Hence, selected teachers and leaders from the Faculty of Technology were the first participants in the initial reform activity; of course in collaboration with the ECBP. AAiT, as a separate institute, as it is now, did not exist by the time the engineering education reform began; it is rather one result of the reform itself.

The Faculty of Technology at Addis Ababa University during that time comprised seven departments of Architecture, Chemical Engineering, Civil Engineering, Electrical and Computer Engineering, Construction Management, Mechanical Engineering, and Urban and Regional Planning. It was selected by the ECBP because of its relative strength compared to other engineering education providing institutions in different fields of engineering studies.

The strength of the faculty at that time was manifested in different aspects. There were 49 PhD, 58 M. Sc. and 42 B.Sc. holders excluding part time staff (Bayou, et.al. 2006: 38). According to an assessment conducted by Cordier in 2007, during the start of the reform, the Faculty of Technology had sufficient and the best staff available in Ethiopia “qualitatively speaking” (Cordier, 2007: 41) who could run bachelor and graduate program. The quality of the Faculty’s staff was not only dominant in the academic field but also in the field of practice (Cordier, 2007).

At the time of the reform within FoT there were five M.Sc. programs, out of which four were provided in the present AAiT campus while one was taught at the former Southern campus which is now called as Ethiopian Institute of Architecture, Building Construction and City Development (EiABC). Provision of PhD programs were also on the way to be launched in some departments like Architecture and Urban Planning. Until that time, graduates willing to achieve their PhD have had to go abroad to do so (Cordier, 2007: 40). Even though these were features regarded as a sign for the relative strength of the faculty of Technology, on the other side, the Faculty’s endeavor of teaching and learning was not free from criticisms. Though there were highly qualified teachers and relatively well organized laboratories and workshops for the teaching learning purpose, many people, including its own staff thought that the teaching learning process was inefficient, For instance, the Faculty Reform Steering Committee (RSE) that comprised 10 members of the Faculty and which was established under the framework of the ECBP in 2007 pointed out that:

> *the education in the FoT was not sufficiently practice oriented, graduates were not problem solvers, its administration and governance system is plagued with undue centralization, insufficiency and lack of transparency. Furthermore, the Faculty's weak link to the industry has led to inability to make curriculum and research relevant to the needs of the country and, therefore, has resulted in its limited contribution to the national economy* (RSC, 2007: 6).

A participant of this study also confirms this by saying:

> *When we look to the curriculum that existed before the reform, I can say that students who graduated through it lacked getting exposure to the industry before they graduate. But that does not mean that they were not capable of handling the duties they are assigned for. Probably they may have needed sometime initially until they get used to it* (N.18. p. 337).

It is likely that the identification of such pitfalls could have served as one of the catalysts for the undertaking and implementation of the reform at the level of ECBP and at the level of the Faculty of Technology. In other words, such pitfalls and the inherent drawbacks were the important aspects that were needed to be addressed and changed within the activities and implementation of the reform. As pointed out by one of the participants of this study, the reform was directed towards improving the teaching learning process, the linkage between university and industry, and the inclusion of more practice in the engineering teaching. This reads as the following:

> *The reform introduced many things in the curriculum which included the improvement of teaching learning process, university industry linkage and the creation of practice oriented engineers who would solve problems associated with many sectors within the country* (N.17: 298).

4.3.3. The Engineering Curriculum Development Process

The major points that are addressed under this theme include: policy initiative, curriculum development within the institution, and teachers' participation in curriculum development.

4.3.3.1. Policy Initiative

As it has been mentioned earlier in this Chapter, the engineering curriculum reform within the present AAiT (formerly known as Faculty of Technology) was stimulated by the ECBP. The ECBP from the outset shared its ideas of engineering reform to Addis Ababa University which was finally delegated to the Faculty of Technology. As an old and experienced institute, the Faculty of Technology was perceived and expressed as follows:

> *The most eminent role presently has the Faculty of Technology (FOT) at Addis Ababa University (AAU), being the oldest and most advanced faculty in the field of technology. Besides, there are 8 faculties of technology and engineering at regional universities throughout the country. The Analysis of the FOT at AAU gives indications for necessary changes in the governance system. Detailed assessment of the regional faculties will have to be included in a later stage.* (Cordier, 2007: 3-4).

The ECBP focused on the Faculty of Technology, more than any other institutions, to start and work on the reform due to a number of reasons as pointed out herein below:

> *The higher education institutions that offer programs in technology, however, have a widely varied level of development. As it is well known, due to its more than half a century of service and development the Addis Ababa University (AAU) possesses relatively more adequate staff and infrastructure. It is also well known that both the public regional and the private universities depend considerably on the graduates of the AAU* (Cordier, 2007: 36).

The response of the Faculty of Technology to the call of the ECBP was positive to the extent of being “under the direct support and guidance of the ECBP” (N. 20: p.372) in carrying out the reform activities. This was further expressed as “it was actually receiving guidelines and the objectives and ideas sent from the Ministry to make the reform. The university was simply collaborating. So everything, all in all, was done under the Ministry of Capacity Building” (N. 20: p. 372). Within such set up a steering committee comprising 10 staff of the faculty had been established to oversee the FoT reform under the University reform component of the ECBP and followed by setting up of different task forces that dealt with curriculum, industry linkage, E-learning and ICT development, and Governance and organization of reform, (RST, 2007: 6) all of which were contributors to the reform in one way or another.

Even though the Faculty of Technology was regarded as the strongest of the then existing engineering education offering institutions, in terms of having diversified engineering departments, well qualified teachers, and relatively well equipped laboratories, as it is indicated herein above, there were admitted discontents with regard to its inefficiency of not producing engineers that were geared to problem solving. What was pointed out in this regard included that the Faculty of Technology lacked demand driven curriculum, practice oriented teaching learning process, it was hence, characterized by an imbalance between theory and practice in its teaching and learning, absence of graduate programs in marketable trades, absence of entrepreneur training and lack of adequate apprenticeship were among the prominent criticisms provide by then. A participant of this study puts it as the following:

> *In the previous versions of the curriculum emphasis was not given to practice and industry oriented approach. It was mainly focused on theoretical aspect of engineering education. So through time, especially during the recent review of curriculum by the ECBP, it was tried to incorporate some practical aspect of engineering so that the students can get acquainted with industry practices* (N. 18: p. 321).

So, the attempt of engineering curriculum reform was to alleviate such problems and to produce engineers who have the knowledge, skill, and attitude that enable them to solve problems.

4.3.3.2. The Curriculum Development Process within AAiT

As it has been indicated all the way through the preceding discussions the staffs in the Faculty of Technology were active participants of the reform activity along with the ECBP, especially at the beginning. Mention has also been made that different task forces were established under the umbrella of ECBP. In each of the seven departments of the Faculty of Technology reform committees were formed who ultimately developed the curricula for each of the fields of studies in the respective departments (Bayou, et al, 2006: 7). For instance, members of the task force in the department of mechanical engineering comprised four Ethiopian staffs, including the department head, and one professor advisor from Germany. Likewise, the task force in the Construction Technology and Management comprised five Ethiopian staffs and a professor advisor from Germany. In a similar way, the task forces in the rest of the departments developed the curriculum in collaboration with one advisor assigned to each of them.

The steps involved in the curriculum reform or in the curriculum development, as pointed out by one of the participants of this study, were totally different from what was previously known and practiced curriculum development or revision experiences in the context of Ethiopia (N. 20: p. 373). According to this participant, the first step in the curriculum development process was identifying and developing "the professional profile of the undergraduate program" (N. 20: p.374). For this purpose individuals from industries were contacted in many different forums, interviews, and assessments were carried out to find out or identify the kind of engineers needed to produce and to establish the professional profiles.

Moreover, the then existing curriculum was checked for what it had and for what it was missing. It was revised "in and out" with the collaboration of the experienced German professors. Nevertheless, according to this respondent, the curriculum was basically developed by the faculty staff (N. 20: p.375) in a long process as described by his own words in the following:

> *…this took a long process actually, because you know, after each stage of development the industry was contacted for inputs and critics, and of course through the use of different workshops now and then for consultations under ECBP. So, the process went through the ECBP all the way through* (N. 20: 375).

It is believed by the participants of this study that the curriculum developed in that process included the practical aspect of the engineering education such as that of the internship program, the kind of project work to be dealt with, the time allocation, and the balancing of all these so that the graduates would have the confidence in solving problems in the end,

But this was not done without any challenge and debate, as pointed out by the participants of this study. One of the points raised as an issue was the balance between theory and practice. There was an idea that suggested the eradication of more of the sciences and the theoretical parts of engineering education and focused more on the inclusion of practical aspects. On the other side, teachers of the faculty, although they accepted the inclusion of more practical experiences and students' industry exposure, in the teaching learning practice of engineering education, than it used to be in the past, they did not readily accept the idea of the total erosion of the theoretical aspects. They argued that engineering education, in the real sense of the concept, should not be brought down to the level of more of "technical kind" without enough theory that would develop the students' ability of analyzing problems sufficiently. This was expressed by a participant in this study as follows:

> *Since we were many times blamed as theoreticians, which in my view was a bit exaggerated, even industries, when we ask them, told us that our education is focused more on theory and less on practice. But we argued that is how it should be because this is a degree program and it is a university level education not a technical education. We also said that the missing practical gap must be dealt with another level of education like technical education, but the engineers must have an acceptable level of theoretical base so that they would be capable of analyzing critical problems important for their field* (N. 20: p. 377).

As pointed out by the same participant the arguments between the idea of including more practice in the engineering education and the idea of maintaining a fundamental theoretical base in the sciences, mathematics and engineering sciences on the other side, were the two competing arguments that were mainly treated during the time of the curriculum development process. Through such arguments and challenges, according to the participants, served in creating a "balance" between the two competing ideas and resulted in the reformed curriculum, practicing the curriculum in the real situation is still a challenge that needs more attention.

The other face of the resistance from the side of the teachers seemed to be related to maintaining of the already existed engineering education, probably with some minor changes in the form of plus or minus, and provide that to less number of students. This was expressed by one of the participants as follows: "The previous curriculum was said to be weak by the people from above and the idea of changing the curriculum came from them (N. 19: p.360)". Such statement obviously tends to show that there was an implicit resentment or dissatisfaction with what was done in the reform process. As expressed further by the participant herein below, it shows the need for more theoretical aspects in engineering education and the practical gap needs to be addressed in other levels than in engineering education:

> *At that time we proposed an alternative of increasing the number of technician training schemes rather than the massification of engineers. Our idea was to increase the middle level technicians/technologists who are more practice oriented at degree level. Industry needs more of the middle level oriented technologists, may be trained for three years; not many engineers; compared to the middle level engineers. …our suggestion was to train somewhat like what the Germans call Fachschule* (N. 19: p. 367).

As this researcher learned later, "Fachschule", in the German sense, refers to the "technical" or "special-training school" which is provided after the end of secondary level education; probably, somewhat similar to what is provided in the technical and vocational schools of Ethiopia.

4.3.3.3. A Second Attempt of Curriculum Revision—Harmonization

Though the implementation of the reformed curriculum was not as it was intended to be and entangled with different problems such as that of large number of students in a class or laboratory and the problem of implementing continuous assessment, more recently, as part of the overall need for harmonizing engineering curriculum from the side of the MoE, teachers at AAiT currently have involved in reviewing their curricula. This time, their involvement in revising the curricula seemed to be as a participant in groups of other teachers drawn from different similar engineering education institutions rather that playing a leadership role as it was in the beginning of the initial reform. The idea of harmonization, as it has been understood by the participant teachers, is the "the MoE's plan for standardization" (N. 17: p. 302). It aims in providing similar inputs to similar courses within different engineering education institutions. The first step in this process was to group the higher education institutions in clusters and allow them to reorganize the curriculum for each of the fields of studies in modularized and harmonized fashion. According to some participant of the participants of this study the idea of modularization is not a new one and nothing is new is introduced in that except trying to improve it. This was expressed by one the participants as follows:

> *Initially, when the curriculum was initiated by ECBP the curriculum was designed in a semi-modularized way. In that curriculum we had modules, but the modules were not grouped in a*

> *definite way. They were scattered all over and this was problematic in the actual teaching learning process* (N. 17 p. 303).

Hence, the process of modularization and harmonization, according to some of the participant, does seem to be changing the curriculum. Rather, it is seen as a way of refining the previous curriculum. This is expressed as the following:

> *Modularization and harmonization is not changing the curriculum. It is a way of harmonizing the curriculum of similar specializations. It is not different from the old curriculum. It is an additional work of refining* (N. 17: p. 306).

However, the idea of modularization and harmonization is not as simple as that. It has additional requirements such as employing continuous assessment that includes more or less the same number of tests or quizzes or assignments (up to six in number) for each course of each semester, conducting classes in similar manner and ways, providing similar content of courses for students at each level and semester, were some, among many others. By the time this research was conducted the harmonized and modularized curriculum was applied only to first year students in AAiT. Students above first year followed the previous curriculum which actually does not require the employment of continuous assessment in the sense of the modularized and harmonized curriculum. Since the modularization and harmonization process is not a finished task its application for the second year students and above is expected to continue progressively in the years to come.

Nevertheless, as there are few supports of the idea of modularization and harmonization there are also others who see the idea as problematic and difficult to implement. This was expressed by one participant as follows:

> *Modularization cannot work for engineering. If we had been asked for advice earlier we would have advised them to drop this idea. But we have not been consulted earlier, but we have been told to do it. I think one who suggests modularization for engineering education must be a person who doesn't have any idea about engineering and engineering education; I would say* (N. 18: 330).

On the other side, the concept of harmonization of the curriculum is seen as a threat for competitiveness. For those who have this view the harmonized curriculum will limit the institutions' competing nature and it would force them just to maintain the minimum standards set in the curriculum. The possibility of going beyond that and to think creatively towards new innovation will be jeopardized. Such an idea which is uttered by one of the participants reads as follows:

> *Harmonization is another problem. I don't know why it is like that. I know that the idea of decentralization is being promoted in this country. But I wonder why it is not working in education. I think every institution has to work independently and maintain its relative competitiveness rather than trying to adjust to a pre-specified ways of doing. Why not every institute try its own way to graduate the kind of engineers who full-fill the professional profile identified and stated in the curriculum. I think the only thing that has to be common for every institution is the graduate profile. The details with regard to how to produce has to be left to the individual institute. I believe harmonization threatens competitiveness. Institutions have to be users of their competitive advantages. Otherwise teaching will remain to be a matter of full-filling minimum standards* (N. 21: 406).

4.3.3.4. Teachers' Participation in Curriculum Development Process

As it has been pointed out earlier, the staff in AAiT, at least those who were involved in the task forces, even though they were not the initiators of the reform, they were active participants in the engineering curriculum reform activities more than any other staffs who were involved in providing similar education in other engineering education institutions at that time. This can be attributed to a number of reasons. First, the option taken by the reform initiators in putting the Faculty of Technology as the first institution that involved in the first practices of the reform. Secondly, the fact that the large numbers of staffs, teaching in the faculty, were more experienced and more qualified in the fields of engineering they were teaching than teachers in other similar institutions. Thirdly, the geographic proximity of the Faculty of Technology with the center of reform initiators gave more chance for teachers to have close communication with the reform initiators than teachers which, at that time were in a similar situation of teaching engineering students in other higher education institutions. Fourthly, the relatively more diverse nature of the programs available in the Faculty of Technology coupled together gave more chance to teachers in the Faculty of Technology to participate in the reform process and to develop the curricula that served as a spring board for other similar institutions.

4.3.4. Perceptions of the Field of Engineering Education and Curriculum

Perceptions of engineering education and curriculum among AAiT teachers is more or less similar to each other and associated engineering education and curriculum with the mechanism of enabling students to solve problems that are prevailing in a society. As a number of participants indicated, engineering education refers to the study of a combination of engineering sciences, related mathematics and the skills associated with it. Engineering curriculum, on the other hand is expressed as a means by which such education is addressed to the students. For instance, one of the participants of this study indicates:

> *Historically engineering was started to solve problems related to security. It is a wide area. Now it is provided to young people in order to make them able to solve the problem that is prevailing within the society. So engineering curriculum is a means for providing this education and equipping students with the knowledge, abilities and skills that would help them to solve engineering problems* (N. 16: 288).

Beyond informing the historical background of the development of engineering, this participant indicates that engineering education is provided to young people to enable them to solve problems. The main tenet, which is repeatedly mentioned by the participant teachers, is that engineering education is associated with solving problems of society and the curriculum is the plan that contained the concepts and principles to be taught to students. Another exemplar expression of this perception by one of the participants reads as follows:

> *Engineering in general is a profession that uses the application of various kinds of knowledge and skill to solve problems of individuals or society and engineering education is education that provides students the knowledge, skills and the techniques of problem solving. So the curriculum is a detailed plan for providing engineering education* (N. 17: 297).

Such perception of engineering education and engineering curriculum tends to imply that engineering education is directly connected to that type of education which has to do with solving of problems, and the curriculum in this sense, has to be capable of equipping the students with the required knowledge, skill and attitude necessary to solve problems. Ideally, this, with no doubt, is inherent in the engineering profession as many would agree. And this idea is what this researcher managed to trace in the curriculum documents of AAiT all the way through. But the question is has engineering education have really produced engineers who are real problem solvers so far? Does the way it is practiced currently assure the production of such problem solvers?

4.3.5. The Content of Engineering Curriculum

As pointed out herein above in AAiT's case there is no varying perspective (as far as the participants involved are concerned) to what is meant by engineering education and engineering curriculum. The content of curriculum in this study refers to the different parts that signify the structure and the arrangement of the different academic and skill components within the curriculum. More specifically it refers to the major elements that are suggested as a means for the education and training of engineers in various specialties such as that of mechanical engineers, civil engineers and others. The aim in this part, however, is not to give a deep analysis of all the elements available in the curricula documents, rather it is to draw the highlights of the important aspects of the provisions and the expectations attached to it and how these are practiced within the institutions.

Until the call from MoE was suggested to harmonize and modularize all higher education curricula including engineering curricula 2012, there has not been any significant change of engineering curriculum in AAiT. The curricula which were developed under the ECBP and which were started to be implemented in the year 2006/07 remained to be the main guiding documents. The curricula, like any curriculum documents in any educational setting, indicate the content that would help to instill the knowledge, skills, and attitudes in students. Hence, in this part we deal with the highlights of the matters related to the expectations of the curricula and its subsequent practices within AAIT.

4.3.5.1. Expectations of the Curricula

Curricula documents in AAiT (e.g., Mechanical Engineering (2006)[3]) indicate that contents in engineering education are identified and organized in such a way that it helps students to be engineers that have the ability to apply knowledge of mathematics, science and engineering design to solve problems, to conduct experiments, as well as to analyze and interpret data, ability to function in multidisciplinary teams, ability to identify, formulate, analyze and solve engineering problems, ability to communicate effectively, and understanding of professional and ethical responsibility in the students.

Content for the development and attainment of such expectations are arranged and categorized in modular structure such as those of General Engineering Skill Module, Basic Science Modules, Applied Mathematics Module, Advanced Mathematics Modules, Humanities and Social Science Modules, Communication and entrepreneur Module, Core Engineering Modules, Workshop Technology, Computer Aided Drafting and Machine Drawing, Engineering Mechanics, Mechanics of Materials, Advanced Mechanics, Material Science and Machine Elements and Supportive Modules.

Nevertheless, curriculum is implemented by teachers and only by teachers. Though not expressed explicitly by their responses in this study, different teachers in AAiT can have slightly different views of engineering and engineering curriculum. For example, for someone who may view engineering curriculum as a "plan for students' in-depth learning of the field of engineering", the purpose of content is likely to be to enable students to acquire deep knowledge and analytic skill with reference to the particular field of engineering study, which may be Mechanical, Civil, or others. The major focus for the teacher who holds such a view is on creating students who are highly knowledgeable and skill-full in the art of analyzing engineering and other related sciences including mathematics without giving enough consideration how these could be applicable in the practical setting. Even though such provision of academic knowledge and skill could be indispensible in almost all professional activities, the aim in providing an in-depth acquisition of analytic skills of the particular field of study obviously does not imply that

[3] AAU Curriculum Reform, Book VIII, Department of Mechanical Engineering (2006), printed at CCC, Münster, Germany.

the students would be enabled in their skill of applying the knowledge they have learned into a novel and practical situation. Nevertheless, the explicit responses of the teachers in AAiT, with regard to what is meant by engineering education and engineering curriculum, as indicated in the above section of this study, refers to enabling students to solve society's problem.

4.3.6. Teaching and Learning: The Interface between Engineering Education Curriculum and Engineering Education Practice in AAiT

Curriculum development or curriculum planning is one thing and curriculum implementation is another thing. Curriculum implementation as an extension of curriculum development requires inputs of its own to result in the desired output in terms of what students know and what they can do at the end of their specific learning. Curriculum implementation in engineering education cannot be a matter of only using pieces of chalks and other writing and reading materials within a classroom situation.

The requirements for teaching engineering education, compared to the requirements of teaching many courses in the social sciences or humanities or other courses, are numerous and varied. Workshops and laboratories with a special arrangement for each of the fields of studies, special machines and equipments for each of the fields of studies, highly trained and experienced teachers and many other resources are among the primary requirements. The ultimate success in obtaining the desired outcomes depends by and large on how these requirements are fulfilled and on how effectively they are used.

In other words, there is no guarantee that institutional settings of the same level and the same status would implement the curriculum alike. Implementation of the same curriculum at different settings could yield different results in terms of, if not quantity, the quality anticipated and sought in the curriculum document. The reasons for their difference may come from different sources such as the conditions related to the physical setting of the institution in which the curriculum is executed, the capacity, motivation, and qualification of teachers involved in executing the curriculum, and the availability and sufficiency of physical and material resources necessary for executing the curriculum.

4.3.6.1. Engineering Teaching in AAiT

As pointed out in the preceding parts of this study, AAiT has a long experience in teaching engineering education and relatively well qualified teachers. But the implementation of the reformed curriculum was not so easy to undertake even at the start. It was knotted with multifarious problems. As pointed out by the participants of this study, it appears that fulfilling the requirements of curriculum implementation, by then, was given little attention. Hence, it was begun without enough preparation in terms of facilities, equipments and other teaching learning materials. In fact, as it has been mentioned herein above developing the curriculum was one thing and its implementation was another though the two are, in a sense, inseparable.

Even though the curriculum developers, most of whom were teachers of the Faculty, and who worked in collaboration with the advisors from Germany, had made estimation of the cost required for upgrading of facilities such as workshops and laboratories, and equipments, required for the proper implementation of the new curriculum, implementation was began prior putting them in place and started in uncomfortable situation as it is described by one of the participants of this study here in below:

> *The first thing we faced was lack of workshops to practice the "Orientation" course for the first year first semester students. There was no workshop in the faculty to accommodate that huge number of students (which was 2800 students of one intake). So it was not possible to handle. The existing workshops were occupied by students of other level. We finally rented a training workshop somewhere around Lideta which was dedicated for training of industry personnel and shuttled our students for practice in that workshop every day until the end of that course.* (N. 20: p. 386).

The problem with the large size of students was not the only a problem constrained the provision of engineering education at the start. Shortage of classrooms and teachers was also the other side of the problem. The classrooms which were accommodating 40 to 50 students previously were later filled with 90 to 100 students. As a result, teaching-leaning in a classroom situation was limited mainly to the lecture method rather than employing other methods of teaching and learning which are believed to be better than the lecture method.

Although the usefulness of other teaching strategies is being widely examined today, the lecture method still remains to be a dominant way of delivering courses to the large number of students (ranging from 90 to 100 students in a class) at AAiT (N. 16: p. 291). Of course, the traditional lecture method, if used in conjunction with active teaching strategies can be an effective way of teaching and to achieve instructional goals. However, engineering teachers at AAiT as well as students do not seem comfortable with the present arrangement of the class size even for the lecture method as pointed out by one the participants:

> *The problem in these days is the large number of student population. The number of students in a class ranges from 80 to 100. Moreover, what is required these days is to employ continuous assessment and to use the result for improving the teaching and students' learning. But the large number of students per class and dealing with more of such classes makes it difficult to practice what is required* (N. 16. p. 291).

Even though the situation in AAiT is relatively better than the other institutions in terms long experiences in teaching engineering and in terms of having better qualified teachers, participants in this study feel that quality in engineering education is not improving as per the requirements specified in the curriculum due to the increase in the number of students and the incompatibility and insufficiency of the necessary teaching learning materials and equipments required. Almost all participants share the idea that the question of improving the quality of engineering education is not well addressed yet and it is still problematic. One of the participants describes the situation as follows:

> *Even if we try to employ practical exposure of students, such as internship and other work of practical nature, there is still problem of quality. Obviously, quality goes down with the increase in the number of students. For instance, in my time of undergraduate study, one batch was only 80 students. Last year there were 100 graduates and this year it is roughly 800 students. Next year it will be about 400 and in the year after it will be 1200. So you can imagine how drastic the change is* (N.18: p. 339).

The other problem that threatens quality of engineering education is shortage of well qualified teachers within the institute. According to some of the participants, sometime in the past, many of the teachers in engineering education were PhD holders. But these days, there are cases where graduate assistants teach "full courses" to students.

Students who were participants of the Focus Group discussion set by this researcher also confirm to this reality. They indicate that some of the teachers who used to be students like themselves a year before, begin teaching courses soon after they secure their employment as a teacher without any other technical or teaching experience. For instance, one student participant points:

> *Nobody knows how the teachers are selected. In fact they may have the highest grades during their graduation. We see teachers who do not have the ability to teach; even in the subjects they scored the highest grade during their learning. I think the criteria for selecting teachers is high score upon graduation*. (FG. 2: p. 411).

What students indicated here is worthy to consider. They know that scoring high grades is one of the criteria used in employing teachers for higher education. But they do not know what additional criteria are included in the whole process of employment. According to them, relying on high scores for selecting teachers in higher education is sometimes misleading because of the following reasons: (1) high scores in the existing situation of teaching and learning is not reliable due to unavailability of standardized tests and examinations provided; (2) there are a number of possibilities for obtaining high scores other than putting too much effort in the learning, which are simply dependent on the individuals' capability of knowing the tactics of scoring high in each of the courses provided. According to them these include: (a) obtaining past examination and test papers and working on them, (b) knowing the specific characteristics of the teacher who teaches the subject and acting as per those characteristics, (c) using colleague students as a source of getting summarized information and summary of the lessons; and (d) In rare cases, obtaining the exam papers in unknown ways.

According to the participant students, most of the students within the institute, including themselves, use one or more of these tactics to exist as student within the institute. But they do not deny that there are very few individuals who stick to their study properly, digging deep into the subject and having control over the knowledge and skill required. According to the participants of the focus group these students are not many in number compared to the vast majority of students, and sometimes they may not be the ones who score the top scores.

4.3.6.2. Internship as a Method of Teaching

Another significant point which is raised as a problem in the teaching learning process of engineering education in AAiT is the use of internship. A close examination of the curricular documents reveals that internship is a mandatory component of engineering education. In many cases students leave their campuses for one semester long internship training in industries after they completed their six semesters of in-campus study. Internship is believed to be potentially important for engineering students as it gives them the chance to know and understand the realities in work situation. It is also believed that the practice in internship would help students in filling the skill gap which they don't get during their in campus studies. But its application so far is not regarded as satisfactory by teachers, students, and industry personnel who participated in this study. Let us see below how this claim of the reality is revealed by a participant teacher:

> *Students will be exposed to internship for one semester but it is not conducted as we expect it to be. Because many students, from various universities join in the practices of internship and they occupy the spaces available in the surrounding industries. As a result, students will be forced to look for industries outside Addis Ababa; a situation which is not convenient for both students to meet periodically* (N.17. p. 307).

Since more of the larger industries, with the capacity of providing the skills needed by students are situated in Addis Ababa, and this is not the case in other areas, it would not be difficult to speculate that more and more students from various universities could come to industries situated in Addis Ababa for their internship. This is said to be one of the 'bottle neck' for students in AAiT to practice internship properly. This is also confirmed by one of the student participants as follows:

> *The practical skills we receive in our workshops are very limited. In addition to that we sometimes go out for industry visits. It is like an entertainment for many of us; we neither write report on it nor we do research in connection with it. The other is internship. It is also problematic. For instance, it is me who found an industry for my internship practice since we were forced to do so. But there was no follow-up from our teachers during our practice there.*

As can be seen here, the concern of the students is lack of follow-up from the side of the teachers. This also seems consistent with what one of the interviewees of this study from industries has indicated.

> *Students come here sometimes by their own and sometimes guided by their teachers without identifying their specific area of practice. Neither the teachers nor the students tell us what they want and where we specifically put them for their internship training. We always face problems in*

> *this regard. Students have to identify some specific areas before they come for their training* (Ind. 4: p.).

It is worthy to note here the message implied by this interviewee. The message is not difficult to understand. It is crystal clear. The practice of internship has to be guided by some kind of well defined principles. It also requires that students have to identify clearly the areas of skill on which they should focus more, rather than coming up with a broad area of a field of study. It also suggests that both teachers and students must be knowledgeable and have a clear idea about the internship training on which the student focuses.

4.3.6.3. Student Assessment and Quality Assurance

In examining the curricular documents at AAiT one can understand that student assessment before the reform was restricted mainly to students' writing of mid semester and final exams. However, some project works and assignments also made part of the final assessment (Imam, et al, 2006: 27). But the reformed curricula, at least in the descriptions provided with regard to assessment, stipulate that assessment needs to be continuous and that a "holistic" examination, which includes the overall students' understanding of the courses they have learned within the three years, be employed at the end of three years of study. However, when one further examines the assessment mechanisms with regard to each of the courses, assessment seems to be limited to 10% assignment, 30% mid exam, and 60% final examination. Student assessment in AAiT has not changed much in the sense of what is suggested in the reformed curriculum. Neither continuous assessment nor the "holistic" examination is addressed properly. The reason for not applying continuous assessment is attributed mainly to the large number of students that every teacher has to handle. According to the participants in this study:

> *When grading students' knowledge/competency the criteria and the activities included are the Mid and Final examinations. Projects (where applicable) and other assignments are usually given in groups. These days it is very difficult to give students individual assignments due to their large number in each group.* (N. 16: p. 296).

From this, one can see that student assessment is more limited to mid and final examination. It is only in some cases that assignments and projects are included as part of the student assessment. This implies what the curricular documents suggest, as a rule of thumb for assessment, is a futile exercise that remains on the document rather than serving as a practical guide and working instrument.

The other important thing that deserves due consideration here is the suggestions provided by the curricular documents with regard to the "holistic" examination. As it has been mentioned in this part of the study earlier, the curricular documents indicate that students will take a holistic examination that includes the content of the courses they have covered until that particular time. But it appears that no one is responsible to apply it so far. Some of the teacher participants in this study do not have even the slightest idea about whether it existed or not and what is happening with it.

> *This idea is raised by many people. But it is not yet implemented. I am not sure whether other universities have applied it. I think this has to be done by the Ministry or by any other government bodies* (N. 17: p. 319).

Even though the curriculum suggests those assessment mechanisms the way it is addressed in the practical situation appears to be very limited and the practice of assessment at AAiT as pointed out by participant students herein below, is not contributing much either to the improvement of the teaching learning process or to students' learning. A statement posed from one of the focus group participants expresses the following:

> *For many of us the concern is to pass the examination. To pass examination and score good mark is not a very difficult task. What is needed is, simply to collect some past examination papers and work on it, attend lectures, and read the areas the teacher tell you either from the handout he/she provided or a chapter or so from a book. There is no need to take too much time and read different books in the libraries. That is how most of us work and pass examination; and that is what teachers put it in our mind. They tell us on what to focus for our examination, to refer to the lectures they provided, and sometimes the handouts they have given us* (FG. 2: 409).

So what we understand from this is that there is no serious involvement or engagement of students in their own learning a situation which may be attributed to the failure or incapability of the assessment mechanism to do so. Though what some people, call "deep learning" of students is a situation favored to be accomplished by students, what students do is more of what is known as "surface learning".

Another important element to be considered is the question of curriculum evaluation. We do not often find the term curriculum evaluation in almost all of the engineering curricular documents examined for this study in the sense we know it in many of the curriculum textbooks and references. Many of the teachers use the term in connection with examinations, and projects that are provided to the students. Of course, these are also called evaluation though not by all, especially in connection with judging the final grades of students. It appears that the term "quality assurance" has replaced 'curriculum evaluation'. As stipulated in one of the curriculum documents, "the quality of the program offered … is assessed by the performance of graduates and the impact they put on the industrial sector of the company". As far as this researcher is concerned, there is no evidence of such a program assessment so far.

4.3.7. The Challenges of Engineering Curriculum Implementation at AAiT

Challenges of engineering curriculum implementation in AAiT are many. Thus, what is pointed out here is simply a brief description of some of the significant challenges which are related to engineering curriculum implementation within AAiT. Teacher quantity and quality, student population and lack budget and resources are referred to as challenges.

4.3.7.1. Teacher Quantity and Quality

As mention has already been made earlier in this study, AAiT has relatively more qualified teachers than the other similar institutions. It also has a long time experience in providing engineering education. The fact that it is situated at the center of the capital, Addis Ababa also gives it a better opportunity to be linked with many of the country's renowned and big industries since most of these are located in Addis Ababa. Even though all of these features are the true facts of AAiT, the students in the current undergraduate engineering programs do not seem to be the beneficiaries of most of those resources. Participant teachers and students associate this with: (1) the shift to and more involvement of senior teachers in graduate program instead of teaching in the undergraduate program; (2) attrition of better qualified teachers in search of better options in terms of benefits like better salary and study opportunities abroad; (3) the vast number of students in classes, labs, and tutorial sessions, as this limits the possibility of student contact with teacher, laboratory equipments, and workshop machineries, tools and gadgets and (4) the involvement of more and more junior teaching staff in teaching senior level courses. Focus group participant students also recognize that there is a serious problem in the way they are taught and by whom they are taught. For example, one of the focus group discussion participant students puts the problem as follows:

> *For instance, in our department there are three best doctors whom we know. But they are not teaching at undergraduate level. They teach at graduate level. If such teachers would teach the undergraduate level, I believe many students would like engineering as a field of study more than they do now and would perform better. The base for engineering education, as to me, has to be good at undergraduate level. If those senior and experienced teachers teach at undergraduate level, I am sure we would be better engineers than we are now and we will be good problem solvers ultimately* (FG. 2: p.424).

4.3.7.2. Student Population

The lecture class size in the case of AAiT, as pointed out by the participants of this study, is 90 to 100 and in some cases 80 to 100. Likewise, lab and tutorial classes are conducted with a minimum of 40 to 50 students per lab or tutorial sessions. Such problem is expressed by one of the participants of this study as follows:

> *Instructors kept trying to teach as much as their capacity allows. But the large number of students per class hindered the need for addressing the requirement of feedback. In spite of the large number of students and the shortage of resources, I don't see any problem on the structure of the curriculum* (N. 16: p. 294).

Teachers teach two or more of such lecture sessions or lab and tutorial sessions. Sometimes a teacher may teach more than one course for different groups of students arranged in a similar way, and requiring the teacher's preparation for two courses for that large number of students. Moreover, teachers have the responsibility of enabling students to acquire the skills of using laboratory equipments that would help young engineers do their work in the future. The teachers try to discharge such responsibility in a situation where laboratory or workshop facilities are not furnished properly, where students are crowded during each lab, tutorial and workshop sessions and where they cannot follow-up students' activities. Even though one appreciates the opportunity provided for many students to learn engineering, the quality compromise, that follows with it as observed by the participant of this study, is not a problem of the individuals who are currently involved in it, but a problem to the nation as a whole which has consequences in the development of industries and other sectors which demand the use of engineers.

4.3.7.3. Shortage of Resources for Teaching and Learning

The effectiveness of implementing curricula by large depends on the existence material and human resources which may be expressed in terms of well equipped classrooms, laboratories, workshops and the availability of sufficient number and well trained teachers. Without availing such resources as per the standards, it is unlikely that learning will take place properly and the desired results would be obtained. Even though AAiT has a long experience of teaching engineering and the facilities are better than any other institutions involved in teaching engineering, as pointed out by teacher participants as well as students, it cannot be said that all the facilities are in place and materials are plenty. For instance, one of the participants in this study portrays it as follows: *Drawing instruments, the lab equipments, and the books and everything have become under high constraint* (N. 20: p. 397). This, according to this participant, is associated with the large number of students coming to the institution without having enough preparation in terms of availing the necessary facilities and materials required for the teaching learning process by the institution.

Shortages in the facilities and materials can have a negative and irreversible repercussion on the students learning. Once students missed out what they ought to learn as per the set standards and the requirements of the particular course/s, the result at the end will be on the disadvantage of both the students and the society at large. Inefficient engineer will not be confident enough in what he/she does as an engineer. On the other side, the society and industry that are expecting to have and use of the services of engineers will be dissatisfied when they come across such engineers who lack confidence and efficiency in work. The following say of a participant in this study is an indicative of how shortage in the facilities and materials implicate the teaching and learning process. "…then later Massification came and led us to compromise quality. After this occurrence, teaching has become more of theoretical and the idea of project oriented is compromised in many ways" (N. 19: p.366).

CHAPTER FIVE

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY (ASTU)

5.1. Introduction

The analysis in this chapter is based on the following seven themes which are identified and stated on chapter four and the respective categories associated with each of the themes:

- Initiation for Change of Engineering Education and Curriculum
- The institution as a Context of Engineering Curriculum Implementation
- The Engineering Curriculum Development Process.
- The Content of Engineering Education
- Teachers' and Students' Perceptions of Engineering Curriculum.
- The Interface Between Engineering Curriculum Expectations and Engineering Education Practice (Implementation)
- Challenges of Engineering Curriculum Implementation.

5.2. The Institute as the Context of Curriculum Implementation

This part deals with the geographic location, the experiences of the institute prior to the engineering curriculum reform, and the beginning of the engineering curriculum reform within the institution.

5.2.1. Location, Programs and Student Population

The present Adama Science and Technology University (ASTU), is located in Oromia regional state at Adama city, which is found approximately some 90 kilometers away from Addis Ababa in the South-East direction. It is one of the public higher education institutions that was originally established as a Technical and Vocational Teacher Education College in the year 1993 and which is transformed to a university level in the year 2006. By then it was named Adama University (AU) and continued with that name until it finally assumed the present name Adama Science and Technology University (ASTU) in the year 2011.

ASTU, as its name implies, is primarily dedicated to the provision of science and technology education to students who have completed their preparatory education and who come from various regions of the country and who are mandate by the Ministry of Education. By the time the data for this research was collected, ASTU was divided into six schools of: School of Business (SoB), School of Engineering and Information Technologies (SoE), School of Humanities and Natural Sciences (SoHN), School of Pedagogy and Vocational Teacher Education(SoP), School of Agriculture (SoA) and School of Health and Hospital (SoH) (ASTU, 2011: 8). As can be seen here, beyond its primary dedication to science and technology, ASTU as a university, at present, also accommodates a number of other programs including humanities, education and social sciences, and others which are nested within the six academic schools.

ASTU, on top of the academic schools, also hosts institutes such as the Institute of Continuing and Distance Education (ICDE), Further Training Institute (FTI), Adama Institute of Sustainable Energy, Artificial Insemination Institute, and Asella model Agricultural Enterprise (ASTU, 2011: 8).

During the time of collecting the data for this study, that is, in 2013/14 academic year, the statistical data obtained from ASTU’s Office of the registrar shows that regular students enrolled in ASTU, were 16,100, among whom 9,449 were engineering and Information Technology students. The School of Engineering (SoE), from where participants of this study were drawn comprises eight departments. At this juncture the researcher would like to make clear that the present ASTU has made a significant change in the whole of its structure that excluded some of the schools mentioned herein above and has also restructured the previous SoE into a number of different schools. Hence, the data, the analysis, and the findings indicated in this study refer to ASTU before its recent change of structure.

As it has been indicated above, the history of ASTU draws back as an institute dedicated to technology education since the year 1993 and this is described separately in the following section for better understanding of the overall context of the present ASTU. Talking about ASTU without mentioning the highlights of the practices, and to some depth, the overall situation of Nazareth College of Technical Teacher Education (NCTTE), would give to ASTU an artificial identity that grew from nowhere. Because, the different technology departments of NCTTE that served as the starting point of the present engineering departments, a number of teachers who taught during NCTTE, the facilities, machineries and tools, etc, that were used during NCTTE, the culture of curriculum development, teaching and assessment that were practiced during NCTTE, at least partially form the present context of ASTU.

5.2.2. Experience Prior to the Engineering Curriculum Reform: NCTTE as a Technical and Vocational Education College

NCTTE which was previously called by the name Nazareth Technical College (NTC) was established as a public college in the Academic year of 1993/94 as a Technical and Vocational Teacher education (NTC Catalogue, 1995). In those early days, it used to have a mission that was stated as "…to advance the quality of human life through strategically selected program of instruction, research and public service emphasizing programs related to technology" (NTC Catalogue, 1995: iv; NTC Legislation, 1992:1). NCTTE as a college dedicated to the training and education of technical and vocational teachers had programs at degree and diploma levels since its beginning in 1993 (NTC Catalogue, 1995). In the evening sessions, technical degree and diploma programs were also provided for those adults who needed to acquire technical knowledge and skills.

The specialized fields of studies provided in those days included Automotive Technology (degree & diploma), Construction Technology (degree & diploma), Drafting Technology (diploma) (but latter it also included the degree program) Electrical/Electronics (degree & diploma), Manufacturing Technology (degree & diploma), and Surveying Technology (diploma) (like the Drafting Technology mentioned above, the degree program was also included latter) (NTC Catalogue, 1995). The regular degree programs in all of the fields of studies were stretched out to four years of duration while the diploma programs lasted two years.

The curriculum which was used for most of the time in the process of educating the technical and vocational teachers (NTC Catalogue, 1995) was a clearly and soundly reasonably organized educational plan that divided the contents of the student's learning in each of the fields of studies into major, supportive, general and professional courses. Major courses referred to the mixture of technological and engineering courses related to each of the respective fields of studies of Automotive Technology, Construction Technology, and the rest of the fields of studies as well.

Technological courses in all of the fields of studies comprised contents which were thought to be useful for the acquisition of knowledge and skills that have to do something with the manipulation of some machines, tools, materials, or artifacts to gain some visible result/s of a process or an activity. On the other side (as an integral part of the major courses), engineering courses dealt with equipping students with the acquisition and understanding of knowledge of the basic mathematics and engineering sciences which were peculiar to each of the specific fields of studies. A teacher who used to teach in those times and who is currently teaching engineering courses confirms this reality as follows:

> *Before the ECBP initiation there was no engineering program at the university. We used to have technology program which was devised to train technical and vocational teachers rather than pure engineering. The courses provided then were more of practical nature compared to the courses in the present engineering program* (N.1: p. 2)[4]

[4] The responses of the interviewees were coded by number and letter. I used the particular paragraph number into which the quotation is found in the primary document. For example (N.1, p 2) refers to the response of Interviewee number 1 and the quotation is located in paragraph number 2 of the transcribed text.

Almost all respondents who used to teach courses of the technical and vocational teacher pointed out that there was no full-fledged engineering program but there were engineering courses within the technical and vocational teacher education program. In spite of lack of evidence for how the first curriculum was developed, curriculum development in the main part of the subsequent years at NCTTE referred to either the development of additional program/s within the broad canvas of the technical and vocational teacher education program or the inclusion of some new courses to the then existed program or the elimination of courses from the program.

Initiating a new program or including a course to the existed program or excluding a course from a program was the responsibility of the departments which represented each of the major fields of studies. Initiatives for starting new program and development or inclusion of new course/s on the existing program or exclusion of course/s from a previously existing program had to start and emanate from within the departments, either initiated by individual teacher/s or by a group of teachers in a given department. So, teachers within the departments, with no direct interference from outside, were fully responsible for the entire curriculum initiation, development, and its implementation. Of course, the process of doing it had to be in line with the institutional regulations and had to pass through the approval procedures within the institution.

When we look at the teaching learning process, teaching major courses, and to lesser extent supportive and general courses, in addition to the usual teaching learning process, required some kind of practices to be performed either in the technical workshops or in laboratories or sometimes in both. The curriculum document (NTC Catalogue, 1995) then stipulated that the proportion of time allotted to theory and practice had to be 40:60, that is, 40 percent of the time had to be devoted on the teaching of theory and the rest 60 percent of the time had to be reserved for the teaching of practical skills within each of the fields of studies. This means that students' learning activities of the major courses took place mostly on the workshop floors or within the laboratories than it would have been within the classrooms. In fact, the teaching learning process of both major and supportive courses by large involved the use of workshops or laboratories and the manipulation of machineries, tools, materials, and other artifacts. So the act of teaching, in such cases, referred to what teachers did in both classrooms and workshops or laboratories in order to put in effect the ultimate goal of student learning. Most of the teachers, including the expatriate teachers from Germany and India, who were in the teaching position by then were supposed to teach both theory and practice and they had the responsibility of conducting both classroom sessions and workshop practices.

Methods of teaching and learning the theoretical parts of the technological courses within the classroom situation, by large, involved lecture method accompanied with some visual displays of overhead projection and to a lesser extent group discussions. Group learning activities were more visible in workshops and laboratories than they were in the learning of the theoretical aspects within the classroom situation. Student learning in workshops or in the laboratories involved dealing with some kind of experiments and observing the results of the experiment in most understandable way or on the manipulation of machines and materials in the process of producing tangible products.

Teachers' preparation for the theoretical part of the teaching and learning process was no more than preparing handouts, and in a lesser extent preparation of transparencies for overhead projection (that was the only advanced teaching aid at that time). However, lecturing remained to be the most dominant teaching and learning method for most part of the teaching of the general and professional courses within the broad program of the technical and vocational teacher education.

The method of assessing students' performance in almost all cases of the theoretical parts, by large, included the use of one mid and one final examination per course per semester. Though this was what was officially recognized, teachers, in addition, were advised not to depend exclusively on those two forms of examination results and had to use other forms of assessment mechanisms such as assignments, some forms of project work, and short tests. This, however, was left to the discretion of the teacher.

Perhaps due the more efforts and time it required, the other means of assessment such as assignments and projects, in many instances, were not favored by many teachers. Most of the teachers preferred to employ mid and final examinations and it remained to be the dominant way of student assessment. Nevertheless, assessing the practical aspect involved more of practical tasks. One of the teachers who used to teach the technical and vocational teacher education courses during those days and who is a participant of this study describes this situation as follows:

> *When we were teaching the 'would be' technical and vocational teachers it used to have more practical work, and assessment seemed to be more of continuous due to the nature of technology education which involved more of practical and lab work and due to the manageable size of the student number. But now partially due to the nature of engineering education itself, and to a large extent, due to the huge size of the student number the focus has shifted towards the provision of more theory than practice* (N. 4: p.67)

Learning courses of practical nature, during those days, required students to perform some activities related to the manipulation of machinery, development and production of practice models, pieces of some useful materials, artifacts, and more in that line, The quality of the product produced by each of the students or in groups or in both groups and individually, measured against a certain kind of criteria set by the teacher, eventually built up to be part of the assessment and that included many similar or different pieces, depending on the nature of the particular course. So, the act of assessment related to the practical performance of students at NCTTE was more of an integral part of the teaching learning process rather than a separate part which was done within a short span of fixed time. The good thing, as pointed out by some of the participants of this study, with that kind of assessment was the promptness of the feedback from the teacher that gave the students chance of correcting the mistakes immediately and improve its quality as per the specified requirement/s.

Teaching and learning in the technological fields of studies, in those days, needed not only the commonly known facilities in any kind of school setting such as classrooms, books, and the like, but also materials completely different from those ones. It needed laboratories, workshops, classrooms, and the relevant equipment and machinery as well as books and other educational materials. Though it was for only 800 students, these were in place and students were able to use them and to practice on the available machines and their accessories sufficiently as required.

All of the workshops by then were moderately equipped with the necessary machines and equipment, accessories, tools and other supporting materials required for the teaching and learning of the skills in each of the fields of studies. In fact, consumable materials of different nature in the different fields of studies were not in abundance, and it remained to be a problem throughout.

Though the workshops and many of the equipment within them are now too old and some of the equipment and machines are also obsolete, according to some of the teachers to whom I spoke and as I observed it in the workshops, many of the old conventional machines, and some of the associated tools, equipments, and accessories are still useable to create and develop the required basic skills that engineering students need.

To conclude this part, let us first summarize the overall picture. NCTTE, as a technical and vocational teacher education college served from 1993 to 2006. The curriculum in the technical and vocational teacher education comprised major, supportive, general and professional courses. The provision of technical courses within NCTTE also included a number of engineering courses some of which are still being taught as part of the engineering program. Teaching and learning at NCTTE included both theoretical and practical tasks. The culture of assessment within NCTTE combined both written exams and continuous assessment that included project work, handling and operation of machines, and manipulation of different materials.

Some of the teachers who used to teach within the program of technical and vocational education are still teaching courses within the reformed engineering education program. This clearly shows the connection between what was then and what is now in terms of curriculum, the culture of teaching and learning including the ways of student assessment. And this is where the present Engineering School of ASTU stands on and aspires to becoming a “first choice in Ethiopia and one of the distinguished Universities dedicated to excellence in applied sciences and technology" (ASTU, 2011: 3; ASTU, 2012: 2).

5.2.3. Engineering Curriculum Reform in ASTU

The provision of engineering courses as an integral part of the technical and vocational teacher education was an experience that existed up to 2007. This means that there was no full-fledged field of study or program designated as engineering education throughout the college's era and at the earlier days of Adama University (AU) (as it was called then). The idea of introducing the engineering program was a phenomenon that took place after the college was transformed to the level of university in the year 2006. Even though the idea of introducing engineering program was creeping in the minds of teachers and institute leaders at that point in time, it was injected by the ECBP through the government's engineering education reform agenda that started in the year 2005.

Teachers who participated in this study witness that the beginning of engineering program reform within ASTU, from the outset, was influenced and shaped by the ideas of the ECBP and not by the institute or by the teachers within it. The following response of an interviewee locates the source from where the idea of a full-fledged engineering was emanated and introduced, and how it was later developed within the institution.

> *We used to have technology courses provided to the "would be" technical and vocational teachers. That was what we had before we started the engineering program. There was no formal engineering program within our institute prior to the ECBP engineering reform initiative. When we began the engineering program we tried to include more mathematics and applied science courses including design courses. It also required more application of design than used to be before. So, most of the laboratories had to be changed to accommodate and serve the engineering program rather than that of the technology program that existed before.* (N.4: p.61).

If we also see the response of another interviewee of this particular study we get, more or less, the same impression that engineering education was introduced not from within the institute but from ECBP.

> *Before the ECBP's initiation, there was no engineering program at the university. We used to have technology program which was devised to train technical and vocational teachers rather than pure engineering program. The courses provided then were more of practical nature compared to the course in the present engineering program* (N.1: p.2).

As pointed out by the participants of this study, the beginning of engineering education at ASTU was totally a government owned and led program on which teachers of ASTU or Adama University (as it was called then) had to agree, adopt, and implement it. Both the institute and the teachers serving in it, played little or no role at the initial stage of the engineering curriculum development other than participating in workshops which were organized by ECBP and adopt the framework produced by it. This was expressed by one of the participants of this study as the follows:

> *While the curriculum change initiation took place at ECBP, I participated partially in workshops, especially at the later stage of the initiation. I don't exactly know the starting point for ECBP's initiation* (N.1: p.3).

5.3. The Engineering Curriculum Development Process

The interview question on engineering curriculum development process was intended to identify the major parties who were involved in the curriculum development process and the influences exerted since the time of the reform. This was in response to the research question no. 1 stated on page 17. The interview responses are grouped into three broad categories: policy initiatives, the institution, and teachers' participation and presented herein below.

5.3.1. Policy Initiative

As has been mentioned earlier in this part of the study the process of curriculum development in ASTU began and influenced by the ideas of the ECBP. Neither the idea of initiating it nor the creation of the framework for developing the curriculum was from within the institution. To begin the endeavor of curriculum development, some selected teachers were invited to the workshops that were organized and conducted by the ECBP at its head office in Addis Ababa. While some of the teachers participated from the beginning, others participated on some of the workshop occasions. Even though some of them participated on those workshops from the beginning and some at the later stages or in between, many of them did not know exactly how it first began and where the starting point was. Even some of those who thought they knew it, did not have deep understanding. See for example the following statement which was provided by one of the participants in this study:

> *I participated, for a while, when ECBP first initiated the engineering curriculum, especially at the later stages. It was ECBP together with the leading universities such as Addis Ababa University, Baher Dar University, Jima University and Arba Minch University that made the first assessment and came up with the idea of improving the engineering curriculum* (N.3: p.37).

The statement is clear if not true in what it says. However, in reality, there is no evidence of a separate piece of printed (or presented in any other form) assessment study which is particularly geared to engineering education and produced with the cooperative efforts of the ECBP and all of the mentioned higher education institutions.

To understand more of the teachers' understanding of the reasons or the perspectives that drove the engineering education reform which led them to accept and use the framework which was produced by ECBP, let's have a look to what a participant of this study had to say.

> *As far as I know, Adama, Addis Ababa University, Mekele University, and Bahir Dar University, conducted some workshop for about a week to discuss on the engineering curriculum and then Addis Ababa University, Mekele University worked out the draft curriculum and later they gave it to us with a CD. I know some advisors worked with them. I also heard that the framework has included the experiences of different countries such as Germany, India and the UK* (N.4: p.58).

This statement, in its first part, refers to a stage where the different institutions came together, probably to decide on who should take the lead in developing the curriculum, based on the framework which was already prepared. This response also makes visible that a framework was used as a source for developing the curriculum in the mentioned higher education institutions. The same statement, in addition, points out that there was some kind of influence from outside experiences. Whatever the case may be, ASTU, as an institution, at the end of the process at ECBP, received a soft copy of the curriculum (copied on CD) to make its task of adopting it and put it in such a way that it suits the institution. That has become the starting point for the curriculum development process within ASTU.

5.3.2. The curriculum Development Process within ASTU

The curriculum development process within ASTU, as pointed out by the interviewees of this particular study, has never stopped in one stance or two since its first beginning in the year 2007. It kept changing consistently and became unstable until recently. This is presented in the parts that follow.

5.3.2.1. The First Curriculum

Curriculum development within the context of ASTU began based on the curriculum that was developed and handed on to the institute in the form of a soft copy on a CD. The essence of curriculum development in this case then was a matter of adopting what had been received through the CD in such a way that it suits the particular situation. This was performed by establishing different departmental committees within the institution who would accomplish certain related tasks such as needs assessment and collection of relevant materials from different universities, as indicated by a participant of this study in the following.

> *To start with the curriculum development, in our part, we conducted some need assessment that included students and teachers the result of which was used as an input for the new curriculum. After we conducted the needs assessment, we went to Modjo for the actual curriculum development of the …program and worked there for about a week* (N.4: p. 60).

As new beginners of engineering education within the institution, teachers had to visit various engineering institutions to see and collect relevant course materials to use it as input for the curriculum. With all this in place, a retreat from the institution was made to produce the first draft of the curriculum and to make it ready for comments of different parties within the institution as well as by participants from outside. The curriculum developed in this process was then said to be "in the European Standard" though not explained what is meant by the "European Standard" and it could be different things, it was expressed by one of the participant of this study as follows:

> *…The curriculum was so national in its context, because it was produced by the Germans and Ethiopians and it was in the European standard mode in which the evaluation system, the credits were so different. It was in ECTS. The course content and everything was to the level of international standard* (N.9: p.172).

The curriculum, which was the first engineering education curriculum, in the history of the university, was commented nationally “by different intellectuals, industry owners, and by different people” (N.9: p.174) and it was sent to an Accreditation, Certification and Quality Assurance Institute (ACQUIN) receding in Germany for further comments (N.9: p.174). The curriculum, with further inputs from the institute, was again polished and organized in such a way that it could be implemented in the real teaching learning situation starting 2007/2008 academic year. But its service could not last long and was challenged soon after one year and subjected to a new change enforced by a new president appointed to the university. Nevertheless, students who were admitted to pursue their education as per the requirements of that curriculum were consistently attached to it and finished their undergraduate program.

An example of the structure of the first curriculum is depicted herein below for further understanding. It is an example from one department, but all engineering education programs produced at that time followed and used the same structure in their curriculum development. The structure of the first curriculum was a characteristic to only one field of study. Other fields of studies began their curriculum development with a structure similar to what is called the second curriculum herein below. The main difference between the two is that the first curriculum (which was peculiar to one field of study) did not have any stream or specialization at the undergraduate level while the rest of the fields of study incorporate stream, (sometimes called focus area, by some teachers).

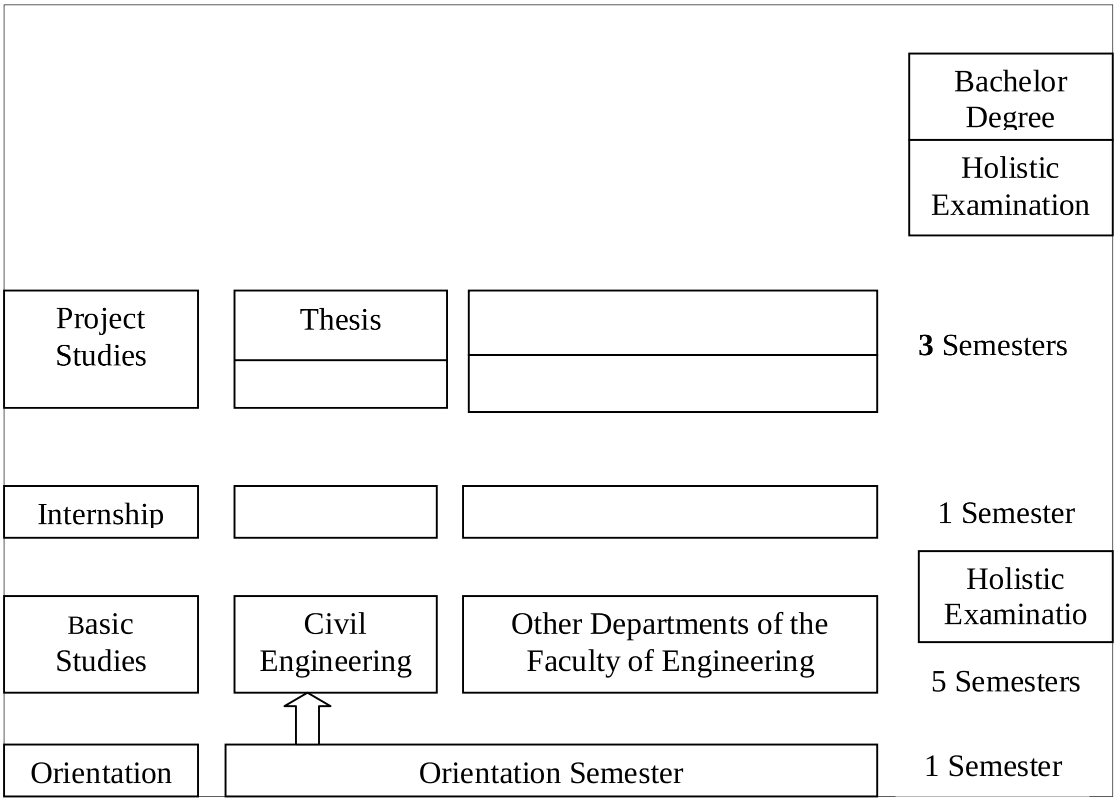


Figure 4. The First Curriculum

Source: Adama University (2007), Study Program for the Degree of Bachelor of Science (B.Sc.) in Civil Engineering.

The first curriculum, as the first experience of curriculum development within ASTU, which was accompanied by one year of implementation, did not leave much evidence behind it, in terms of the results it produced and in terms of the problems it might have encountered. Since it was implemented only once and had ceased after one year without proper review, no one would be in a position to tell its weaknesses and strengths either within ASTU or elsewhere. As per the participants of this study it was changed simply to implement the "New Framework" introduced by the then newly appointed "founder President" of the university.

5.3.2.2. The Second Curriculum

As it is pointed out above, the first curriculum did not serve longer with its original version. Soon after one year of its implementation it was challenged by a new change that was proposed by a newly appointed founder president of the university. Though he allowed the persistence of the then existing curriculum for a while, he eventually declared, in black and white, that Adama University (the present ASTU) would follow "the principles of the Bologna Process and the European Credit Transfer System (ECTS)" (Eichele, 2007: 45). The idea of using the European Credit Transfer System (ECTS) was part of the ECBP's framework and that was incorporated in the first curricula. But the President's ideas were more than using ECTS that included change in the structure of the established engineering education departments and the merging of departments to one another. This was stipulated vividly in his document entitled "Setting up Adama University – A Framework" (Eichele, 2007) and communicated to the staff. Inherent in this move of merging was the idea of strengthening the interdisciplinary nature of engineering education. Though this idea was not opposed officially for reasons unknown, it was clear that it did not please some of the instructors, especially those whose fields of studies became part of another field of study.

Secondly, the idea of streaming students in to some kind of specialization, after three years of common studies, was also not welcomed and supported by some of the instructors. The idea in that approach was that all students with the background of science, in their first entry to the university, learn the common courses together for one semester before they were granted admission to the engineering fields of study. Again after they were granted admission to the specific department of engineering, say Electrical Engineering, they all study the "core electrical courses" together for five semesters and depart to the specific focus areas such as Electrical Power Engineering, Control Engineering and others at the end of the third year. From there, they continue their study in the seventh semester and then they be exposed for internship in the eighth semester. Upon their return from their internship study they continue their study in their focus area for two more semesters until they finally graduate. An example of the structure of the second curriculum is shown on figure 6.

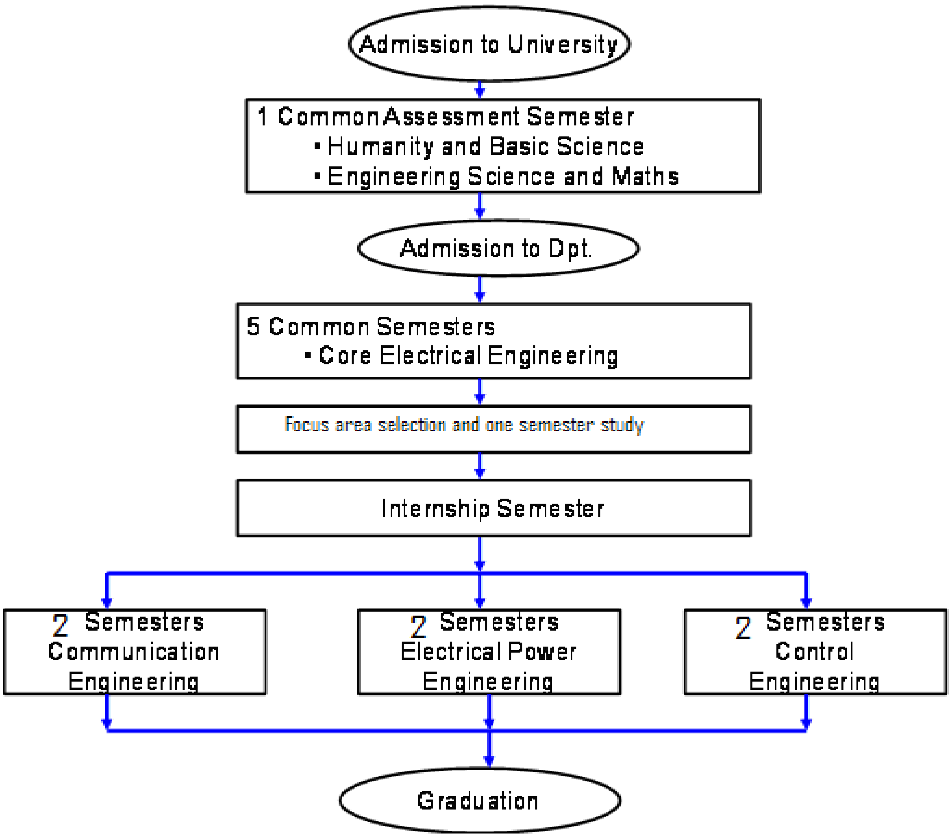


Figure 5. Example of the Structure of the Second Curriculum

Source: ASTU, (2009), Undergraduate curriculum (p. 4), Department of Electrical Engineering.

For some teachers the idea of the second curriculum approach was not acceptable because they thought that it would limit the students' understanding of the broad field of engineering that has to be learned before they opt for a narrow specialization which, in their view, has to come at the master's level. A view that reflected this discontentment was uttered by one of the participants of this study as follows:

> *…said at the first degree level you produce geotechnical engineer, transportation engineer, structural engineer, which is quite different from graduates of other universities and which is not acceptable in any context, like you know when they get into the work market, the company may need civil engineer and probably they (the company) may say "are you a civil engineer?". The graduates may say "yes". But they don't have that sort of degree. Their degree says they are geotechnical engineers, or they are structural engineers or transportation engineers which is different. So, we argued, in fact, that this is not the norm. …but … said, this is my proposal, as per my framework/Bologna. Yes that was it.* (N.9: p.178).

The teachers' concern with regard to the provision of a number of specializations at undergraduate level, that were proposed, at that point in time was not only a matter of sticking to the already existed ways of providing engineering education and the need to continue with it. What concerned them, as they say; it was the shortage and unavailability of qualified teachers in those newly proposed areas and the unavailability of laboratories and other materials necessary for teaching those specialized fields of studies at that point in time. They also had gone to the extent of proposing an alternative they considered suitable for the case at that point in time: This was expressed by one of the participant interviewees of this study as follows:

> *Ok, then, we proposed, if we have to continue, let us start and have students in two fields, i.e., structural and geotechnical engineering, because we thought for the other two, like hydraulic engineering and transportation engineering, we don't have good laboratory facilities, we don't have good trained specialists in that area in our staff, then we said we can't launch these programs. But for those two, geotechnical and structural engineering, we said we can launch. It was simply to satisfy his demand. But, we didn't win any trust in that proposal. Then we started the program as proposed by …* (N.9: p. 180).

Based on that new proposal, a changing many aspects of the previous curriculum was started. Some of the full-fledged departments (e.g., Surveying) were made to "migrate" to other departments and lost their status of a full-fledged department. Courses of the merged departments became part of the courses of the department into which they migrate. This totally resulted into a new curriculum system and modular rearrangements. While the first undergraduate engineering curriculum involved the acquisition of knowledge and skill in the various aspects of the specified field of engineering throughout until just prior to graduation, the newly proposed undergraduate engineering curriculum required a kind of specialization upon graduation. The previous curriculum was more of general type which encompassed bits and pieces of many areas of the specific field of engineering, while the changed one branched out into a number of streams (or focus areas) after the third year of students' learning.

In other words, the first undergraduate engineering curriculum tended to produce graduates that were more exposed to a variety of the specified field of engineering knowledge and skill with no or little depth in any one of the specific areas. On the other hand the later curriculum aimed at producing graduates with a sound general civil engineering base but who had a certain degree of specialization in one branch of the specified field of engineering. However, the degree awarded remained to be Bachelor of Science in engineering education all the way through.

The changes in the second curriculum, however, did not seriously affect the basic perspectives or the foundations on which the curriculum depended. Ideas such as the need for more practical orientation, the need for closing the gap between the competencies of graduates and what is needed by the industry, the orientation of using ECTS, the use of "internship" as a means for improving the practice of the students were still in place. But the difference in content of the two curricula was so significant to have a major impact on the final output (graduates), or in other words, in terms of the competencies students would possess upon their graduation. Some of the interviewed instructors do not see the second curriculum as distinct from the first curriculum in terms of the foundations upon which it rests. One of the interviewee in this study puts it as the following:

> *There were frequent changes of the curriculum in the past years. It may vary from one to the other. For example, if I consider the second curriculum and compare it with the first curriculum, there was a change in the course content in the form of some exclusion and some inclusions. It can actually be said it is the refined form of the first curriculum. For example, the mechanical engineering students who were enrolled in the year 2007 were supposed to be mechanical engineers with no specialization or with no focus area. But those who enrolled later and who were made to learn in accordance with the requirements of the second curriculum (who are now in 4^{th} and 3^{rd} year) are having focus area or a kind of specialization especially at their senior year* (N.6: p.106).

Though this was an example from one field of engineering, what actually happened was the same in the other fields of engineering as well. The implementation of different curricula within the same field of study for different batches of students was seen as problematic not only by the teachers, it was also shared by the students. For example, a student participant on a focus group discussion, carried as part of this study, puts the problem of the curriculum in connection with the teaching and learning as follows:

> *The problem with teaching learning is number one, because there is no stable curriculum. ASTU started to graduate engineering students only last year. The curriculum used for them was different from the curriculum of the present 4th year and 5th year students. The curriculum used for the present 2nd year and 3rd year students is also different from the mentioned two. Students who are in the 4th year and 5th year have the same curriculum. For example, we 3rd year*

students have taken common courses, that is, all engineering students; we don't specialize in anything; we don't have specialization (FG1[5]: p. 275).

From what is contained in this quotation it will not be difficult to understand the kind of uncertainties that could prevail among different batches of students within the same field of studies. Many educators and scholars, in general, agree that any change in curriculum has to be in place after the evaluation of the existing one. The practice of revising the curriculum at ASTU, however, does not witness anything like that. Change is a necessary thing in any sphere of life including institutions and programs, so it does in curriculum. But the change sought in this modern time requires a firm base to rest on and a kind of deliberate planning that considers various things such as the economic, social and cultural implications, if it had to succeed in its implementation.

5.3.2.3. The Third Curriculum

Attempts in revising the curriculum did not last with the first and the second revisions described herein above, a third attempt was also made by a founder dean of the School of Engineering. That curriculum revision, like the two mentioned above, did not deviate much in the basic perspective upon which it rested. The need for more practical orientation, the need for closing the gap between the competencies of graduates and the needs of industry, the orientation of using ECTS, the use of internship as a means for improving the practice of the students, were ideas still intact. But the difference here was the need for the inclusion of basic science and mathematics courses for first year students who joined engineering education. The assumption underlying this was that the students had deficiency in those subjects and then they had to be equipped with more of those subjects before they proceed and continue with the engineering subjects. Let us see how a participant of this study coined the different attempts made in revising engineering curriculum at ASTU:

---

[5] FG1 refers to location of the focus group discussion. Since there were three focus group discussions; one in each of the three sites, each are identified by letters FG and the site number into which the discussion was held followed by the paragraph number into which the quotation is found within the transcribed text. For example, (FG1. p.7) represents the focus group discussion held in site one and the quotation is found in paragraph 7 of the transcribed text.

> *Of course, five years back there was a basic reform in engineering curriculum to follow the German paradigm, and curriculum was developed by the ECBP along with MoE. In the case of Adama University, we used it only with one batch. And then on the arrival of a new president from Germany, he came with a new framework, and we started to revise the then existing curriculum to match with the ideas of the framework. Then we developed a new curriculum which lasted with two batches only. After the two batches again another dean came for us and he also came with his own approaches to add some courses during the foundation year assuming that the students are not capable of doing engineering education*. (N.5: p.79).

The third attempt of curriculum revision was also viewed by the same participant of this study, as it was an attempt that suppressed the employment of the government's policy which is connected to the transference of freshman courses such as physics and others to be learned at the preparatory level rather than at college level. This concern was expressed by the participant as the following:

> *This approach was, may be in contrary/or opposite of the country's belief. Because the country's belief is every graduate of the preparatory schools can join the university and do whatever is provided at the university level. So, due to that we struggled to divert, but we failed to convince, then we produced the curriculum. We now have two batches in that curriculum. Then that was the third curriculum including the ECBP curriculum.* (N.5: p.82).

In a similar way, another participant of the study identified and described the third attempt of the curriculum revision that took place at ASTU, as a "unique curriculum" to Adama Science and Technology University which was characterized by the inclusion of subjects that were supposed to be learned at the high school level. He said it as follows:

> *If we come to the 3rd curriculum the change was on the foundation courses. We actually call this curriculum a unique curriculum to our university. It was implemented only in our university. The essence in this curriculum was capacitating students who were coming to the university having different high school educational experiences and enroll to pursue engineering. The assumption that many of the students have deficiency in the subjects like mathematics, physics and other science courses led the inclusion of these subjects in the curriculum. It also included some general courses. So, courses which were supposed to be learned at high school level were included at the foundation year* (N.6: p.109).

What was apparent in all of those attempts of revising the curriculum was the absence of any evaluation or research results that detected the weakness or the strength of each of the approaches. This, as pointed out by the teacher participants of this study had caused uncomfortable situation to them as well as to students joining in different batches. As a result, each semester's course provision for the same level of different batches varied significantly to the extent of causing problem in scheduling and allocation of teachers for teaching the different courses. The frequent changes in the curriculum and the activities associated with it, by no means, was something supported by almost all of the teachers. Teachers were confronted with the activity of curriculum revision from time to time than to deal with the improvement of their teaching materials or involve in research work. One participant of this study describes it as the following.

> *The frequent curricula change hinders teachers from being certain, due to the frequent change of the curriculum. In addition, since teachers also involve in developing the curriculum, in many cases their time is occupied, which otherwise would have been used to improve their teaching methodologies and assessment activities* (N.3: p.42).

The concern in the curriculum is more of a concern on students' learning. Whether it is at primary, secondary or higher education level, talking about the curriculum refers to what teachers as teachers and students as students do, through their interaction within classrooms, workshops, laboratories accomplish. More specifically, it refers to the quality of the output, which is produced using a particular curriculum. The worth of a curriculum does not mainly lie on the quality of the document called "curriculum", but on the quality of the output that it produce. Frequent change in the curriculum in many ways has a repercussion that leaves a blemish in the thought and activities of both teachers and students and society as a whole.

5.3.2.4. The Fourth Curriculum: Modularization and Harmonization as a Means for Integration, Homogeny and Stabilization within ASTU

The curriculum revision practice of engineering education, which is taking place recently is oriented with and rests within the broad perspectives of the airborne terms of modularization and harmonization in Ethiopian higher education system. The newly introduced curriculum is not atypical to ASTU only. It is the result of a joint effort of a number of higher education leaders and teachers of universities organized under the support and leadership of the Higher Education Strategic Center (HESC) of the Ministry of Education within the country. The concept of modularization, as used in this curriculum, is directly related to the ways of organizing the content of an educational program. It involves the arrangement or clustering of related courses or topics of every engineering discipline into a definite segment for use by teachers and students in the teaching learning process within the institutions. An example of a modular arrangement extracted from a mechanical Engineering curriculum is shown on Table 6 for better understanding of what a module refers in the context of ASTU's curriculum development process.

Table 5. Modular Arrangement of Courses

Module No	Module Name	Course Title	Course No.	ECTS	Credit	Lec	Lab	Tut	HS
				CP	Cr	Hr	Hr	Hr	Hr
1	General Engineering Skill	General Engineering Skills	GeEng 1011	2	1	0	3	0	1
		Engineering Drawing	MEng 1011	6	3	2	0	3	7
		Introduction to Computing	IT 1011	5	3	2	0	3	5
		Research Methodology for Engineers	GEng 3011	2	2	2	0	0	2
2	Human and Social Science	Logic (reasoning skill)	Phill 101	3	3	3	0	0	3
		Introduction to Economics	Econ 101	3	3	3	0	0	3
		Civics and Ethics	CvEt 201	3	3	3	0	0	3

Source: ASTU (2011), Curriculum for Bachelor of Science Program in Mechanical Engineering, Mechanical & Vehicle Engineering Department, July 2011, p. 24

Some of the instructors do not seem to be comfortable in the application of the concept of modularization in engineering education. In relation with the current curriculum, one participant interviewee of this research described modularization as follows:

> *…if we look at the current curriculum, it possesses unique characteristics of harmonization and modularization. At the undergraduate level, we have seen the concept of modularization even in the past, but it was a bit difficult to implement it* (N.6: p.111).

Though modularization, as concept, is not new for the higher education system in Ethiopia, as pointed out by the participant in above, knowledge about the degree of its success or failure in its implementation in the context of the Ethiopian higher education system, so far, remains to be obscure and questionable.

As pointed out by some of the interviewees in this study, the other concept, intertwined with the concept of modularization, is harmonization. The concept of harmonization, in the context of the Ethiopian higher education seems to refer, on one hand, to the integration of the resources of higher education institutions that have similar programs with each other in terms of sharing academic resources, expertise, and experiences. On the other hand, it tends to foster the idea of the homogeny of engineering education programs or curricula and the specific courses within each program. As pointed out by an MoE expert who served as an interviewee in this particular study, "about 80 % of the content of each field of study is more or less similar for similar programs in all institutions, but the rest, 20% is left at the discretion of each institution to make its own adjustment in such a way that it suits the context into which it is implemented".

However, the state of homogeny within the essence of harmonized curriculum seemed to go deep to the extent of specifying the method of teaching and learning, the mechanism and the number of times each student has to be assessed for each course. This means any institute or teacher who offers, for example, civil engineering has to act and do as per the specified requirements of the modularized and harmonized curriculum. One of the participant interviewee in this study describes it as the following:

> *The features in the engineering curriculum are to be the same across the entire country. It is nationwide. The curriculum was modularized and harmonized. This included all the continuous assessment approach, the delivery methods, the learning outcomes, the graduate profiles with detailed description. I hope it is better than the engineering curricula we have seen before. And also the curriculum is intended to be more practical oriented than theoretical approach, even though there is a challenge with implementation of this practical activities due to the unavailability of sufficient laboratories or equipments, for testing and conducting lab work or practical activities* (N.5: p.84).

The teacher participants of this study do not believe that the harmonized curriculum has any problem. But they are skeptical for its proper implementation, especially in connection with the huge number of students they deal with in each of their classrooms or laboratories. However, harmonization in the case of ASTU, according to the instructors, is seen as a means for stabilization. It is regarded as a means for stabilizing the now and then changing attempt of curriculum revision, which they consider is unnecessary, waste of time and not comfortable for both students and teachers.

…I believe that this curriculum is better. Because the majority of those constructing and designing the curriculum are different expertise from different universities and these are involved in its construction. It is not developed on the bases of some individuals' or some institutions' interest. There are 31 institutions across the country, 8 of the mother institutions are the leading universities (N.5: p.76).

The value of modularization and harmonization, at ASTU appears to be more emphasized by the heads of departments and deans rather than the instructors. However, teachers, even the deans, including some department head themselves (even though they are promoting it), in many ways, seem to be skeptical about the applicability and effectiveness of the essence of modularization in engineering education. Their state of skepticism, in general seems to emanate from the nature and characteristics of engineering education itself which they say is difficult to implement modularization in engineering education.

ASTU, as a university is relatively young. Even though it had a considerable experience of providing technological subjects in the past, its experience in providing a full-fledged engineering program is very limited and is not more than six years. By the time it began the program the number of teachers who had a qualification beyond the B.Sc. level were very few. That kind of situation still persists, but this time it is with few more M.Scs and PhDs. The frequent attempts made in revising the curricula may be attributed partially to this lack of experienced and well qualified staff within the institution. Changing some parts of the curriculum is always an obvious thing that happens in every curriculum material to suit a particular context or a teaching leaning situation. But what has been seen at ASTU was beyond that which has gone to the extent of determining the type of graduate at the end. The following figure summarizes the process in general:

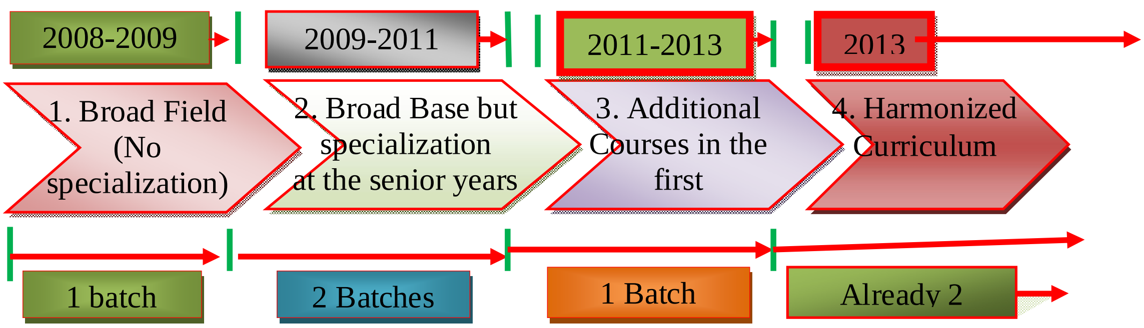


Figure 6. Summary of the different Curricula at ASTU

The variation in curriculum development at different moment did not result only in different kinds of curricula documents but also became a means for graduating engineers whose knowledge and skill varied upon their graduation. While all of the attempts do not deviate much from the base upon which the curriculum had to rest, much of the changes that occurred at different times in the short history of engineering education and its curriculum development tended to create a kind of uncertainty to teachers and students in a number of ways.

5.3.2.5. Teachers' Participation in Curriculum Development

Teachers at ASTU perceive that the initiative for curriculum development takes place without their knowledge and involvement. The different curricula change initiatives that are discussed in the preceding parts of this chapter were attributed either to an external body, notably ECBP, or to individuals who were posted in the leadership position. Though they agree that the curriculum in their subject area or field of study had to reflect the overall objectives of education of the country, they are also concerned about the now and then intervening curricular changes taking place within the institution. In spite of this ill filling, none of the participants in this study showed that their participation would have significant contribution on decisions of curriculum development. But they need to be aware and believe in it why changes are initiated and how it affects positively the teaching learning situation. It seems that they are more concerned on the availability of enabling situation such as the availability of teaching learning materials, machinery, tools and equipments. One of the participants in this study expressed his feelings about the importance placed on curriculum as follows:

> *Management gives too much attention to curriculum, but when it comes to the resources you have, you find it that curriculum is not a crucial problem. With moderately good curriculum and good facility, still we can achieve something good. Change with curriculum alone will not help the training. Equal emphasis, perhaps more emphasis should be given to the laboratory facilities and the development the staff* (N. 3: p. 45).

In fact this view is not directly an indicative of the importance and necessity of the teachers' participation in curriculum development. But it shows that problems of the teaching learning process in engineering education are associated more with the availability of sufficient and appropriate material including well trained teaching staff. This, however, does not mean that the concern about curriculum is not shown by the teachers. None of the participants have an objection to having good curriculum. Almost all of the participants felt that the first curriculum would have served better with minor changes rather than imposing a variety of changes with a short span of time. Though some of the participants put some importance on some of the curricula developed after the first one, most of them have preference to the earliest curriculum. The view expressed in the following quotation is an exemplar of this idea.

> *I personally believe that the ECBP curriculum was the best curriculum which has been number one; it was it was participatory when it was produced; industry, civil engineers, professors, and we were also members. I don't see disadvantage. It was well prepared, well done curriculum. It was the best curriculum* (N. 9: p. 185).

Contemporary curriculum scholarship places teachers in a central role in curriculum development, implementation and evaluation (Handler, 2010). The appropriateness and potential for successful role fulfillment by most teachers, however remains unclear and poorly supported. Researchers and scholars across the past decades have identified "limited engagement of teachers in meaningful decision-making (Handler, 2010: 32). This is an indicative of the teachers in many ways lacked to play a central role in curriculum development especially when it is associated with change.

5.3.3. Perceptions of the Field of Engineering Education and Curriculum

This part deals with teachers' perceptions of the concept of engineering curriculum. Teachers' perception of the engineering curriculum at ASTU appears to vary one from another. Perceptions of curriculum in general seem to fall into different categories. For instance, Fraser & Bosanquest (2006) identified four conceptions of curriculum, which are: the structure and content of a unit (subject), the structure and content of a program of study, the student's experience of learning, and a dynamic and interactive process of teaching and learning. The way teachers of ASTU perceived engineering curriculum, however, seems to be highly dependent on their perception of the purposes of the field of engineering and engineering education. For some of the teachers, engineering curriculum is perceived as a kind of plan which is intended to guide or direct students on what they have to do in their endeavor of learning. For others engineering curriculum is a means by which a country produces engineers who are capable of solving prevailing problems. The third type of perception held by teachers was seeing the curriculum as a means of producing students who are capable of doing things by themselves and who can be creative in the field they are trained. Each of these is treated in the following parts.

5.3.3.1. Engineering Curriculum as a Plan for Students' Learning

Engineering curriculum is perceived by some of the teachers as a kind of plan which is intended to guide or direct students on what they have to do in their endeavor of learning. Such teachers perceive engineering as a field to be studied in depth until one reaches the highest level possible. So the purpose of engineering education is to help students acquire the highest level of engineering knowledge through step-by-step provision of engineering sciences until they reach the highest level. Therefore, engineering curriculum is seen as a means by which students are helped as they go through their learning of engineering sciences. It mainly focuses on meeting the needs of the students. Though said it in different arrangement of words by different teachers, a view of an interviewee which represents this perception of the curriculum reads as follows:

> *In general engineering curriculum is a type of curriculum which directs or makes students towards the … engineering science fundamental concepts at the initial level. Then it grows up from the fundamentals to the specific level which directs them to the specialized direction* (N.2: p.21).

As can be observed from the above quotation, the focus in such perception of engineering curriculum is on the students' acquisition of the subject matter which is related to fundamental concepts of engineering science and which, finally has to develop to the level of specialization. An orientation to such kind of curriculum and its implementation implies the production of engineers who are highly qualified in the engineering sciences rather than in the engineering practices. Another example of such perception of a participant also reads as follows.

> *Students have to be strong enough in mathematics and physics. It demands it badly. I tell you a student who has weak concept of physics and mathematics can never be an engineer* (N.9: p. 2003).

5.3.3.2. Engineering Curriculum as a Means for Full-filling the Country's Objectives

A second type of perception of the curriculum that was reflected by participant teachers at ASTU was a perception that is described in association with what engineers have to do for society or the country, especially in connection to the ability of solving prevailing problems and making society's life better. Such perception assumes a "pragmatic" view which focuses on the practical use of curriculum. Curriculum development in such a case requires close interaction with local practice and those who actually use it. For teachers who hold this perception of engineering education, engineering curriculum is a means by which a country or a community prepares those engineers who would be capable of solving prevailing problems and make society's life better. An exemplar representation of such perception reflected by one of the teacher participants reads as follows:

> *Actually curriculum is devised to make students to achieve the objective or the need of the country In engineering case curriculum is implemented to prepare youngsters to be skilled and knowledgeable people based on current technology* (N.1: p. 1)

Here the focus is on producing students who are capable of acquiring both engineering skill and knowledge and be capable of achieving the needs of the country. The emphasis in such perception of curriculum is on what a young person has to do to the society after the completion of his/her learning, not more of the learning of engineering sciences in depth and proceeding in that way up to specialization. Such orientation to curriculum presumes the attainment of a pre-specified need through providing engineering education to students. However, the acquisition of knowledge, skill and acquaintance with the current technology is part of the focus for students learning.

5.3.3.3. Engineering Curriculum as a Means for Creating Engineers who are Critical Thinkers and Capable of Doing Things by Themselves

Some teachers perceived engineering curriculum as a means for producing engineers who are capable of doing things by themselves and can be creative in the field they are trained. This perception of curriculum is different from what we have seen above in this study. The focus here is on the students' capability of doing things by themselves which may be associated with their attitude and self determination. One such perception of engineering curriculum which was provided by one of the participants of this study reads as follows:

> *The essence contained in the curriculum is producing graduates that are capable of doing things by themselves and who can be creative in the field they are trained* (N.4: p. 71).

An elaborated version of the same perception that is related to an individual's capability and the details of what he/she do as an engineer is provided by another participant as follows:

> As an engineer, one has to have a broader view of engineering than doing things right. because, an engineer often has to supervise technicians and technologists and the engineer's supervision on work is so important, as an engineer, one has to have good knowledge of science, the basic background and it is important to make good balance actually, an engineer should not be theoretician, or he/she should not be a mare skillful person who only knows how to guide, how to bend and fix that. As an engineer, he/she is expected to be a master of the basic science, and the skill as well. He/she must do and must also get nothing done by the technician often you encounter the problem (N.3: p. 39).

The expectation in such kind of curriculum orientation is the production of a versatile and capable person who should fit into doing a variety of things including the management of some work forces at a certain level.

5.3.4. The Content of Engineering Curriculum

It has been discussed earlier in this chapter, that teachers perceive curriculum in different ways. The way teachers perceive curriculum obviously entails a difference on the type of content they select to teach their students and the methods they use in their teaching of the subjects. What is discussed herein below, in a way, can be regarded as an extension and elaboration of those perceptions of curriculum, but this time with emphasis on content. The response of teachers with regard to content was assumed within a broad question of "what do you think is important in engineering education for the students to be successful?" and how do you make it happen?" It was intended to identify the skills, knowledge and experiences that are regarded as important by the teachers for students' learning and what mechanisms they use to make students successful. It was also meant to prompt and identify on what teachers emphasize in their teaching for making students' learning meaningful and useful. Therefore, included in the part below are: expectations of curricula, knowledge and skill base, content as a means of achieving the country's objectives, and professional and personal attributes.

5.3.4.1. Expectations of Curricula

In analyzing the curricula documents in ASTU, the content of engineering education is claimed to be organized in such a way that it creates ability to: apply knowledge of mathematics, science and engineering, design and conduct experiments, as well as to analyze and interpret data, function on multi-disciplinary teams, identify, formulate, analyze, and solve engineering problems, including ability to communicate effectively and understanding of professional and ethical responsibility in the students (ASTU, 2007). To make this true courses are organized in modular arrangements of various categories. A Module is defined as an arrangement of "a set of related courses" (ASTU, 2007: 12). For instance, one of the departments categorizes courses as: General Engineering Skill Module, Basic Science Modules such as Applied Mathematics and Advanced Mathematics Modules, Humanities and Social Module, Communication and Entrepreneurship Module, Core Engineering Sciences Modules: Workshop Technology, Computer Aided Drafting and Machine Drawing, Engineering Mechanics, Mechanics of Materials, Advanced Mechanics, Material Science and Machine Elements and Supportive Modules (ASTU, 2011). Likewise, the other department categorizes the courses as General Science & Engineering, Social Sciences, Communication & Humanities and Surveying modules.

More specifically, the curricula documents suggest that content of engineering education is defined in relation to the competencies identified to enable engineering students to understand and be able to do the things they have to do. This means that the content of engineering education has to focus mainly and be structured around knowledge and skill bases that would enable the students to apply them to a pre-specified ends. This, in the context of this study, means the knowledge and skill that is learned by the students has to be able to create their own profile as specified by the curriculum; not as they would like it to be. This however, does not mean that all the content specified in the curriculum does not contribute to what they would like to be. The mathematical and engineering sciences provided to engineers come from the same root wherever the country may be. What varies most is the degree of concentration and the way it is provided, that is, the availability of materials, the qualification of teachers, the technology used for teaching, and the commitment of the leadership in introducing and enforcing quality boosting ideas.

5.3.4.2. Content as Knowledge and Skill Base

As it has been discussed earlier in this chapter, teachers' perception of engineering curriculum varies in a number of ways. Three such varied perceptions were identified and discussed. Likewise, engineering teachers' perception of content appears to vary considerably and aligned with their view of engineering curriculum. For those who viewed engineering curriculum as "a plan for student's learning of the field in-depth", the purpose of content is to enable students to have deep knowledge and analytic skill with reference to the particular field of study, which is engineering in this case. The major focus of such a view is on creating students who are highly knowledgeable and skill-full in the art of analyzing engineering and other related sciences including mathematics. Even though the provision of academic knowledge and skills could be supported by some type of activities, the aim obviously is to enrich the students' acquisition of that knowledge and skill rather than focusing on the application of knowledge and skill in a rather novel situation and solve practical problem. An example of a response of a participant that reflects such a view of content reads as follows:

> *Students, to be successful, there has to be a good balance of science and mathematics. If a student has to be successful in engineering he/she has to have good background of physics and mathematics. In addition, he/she has to be good in communication skills which include written, verbal, or graphic communications. Most importantly, good views of points to communicate ones ideas around different professionals in the field of engineering* (N. 3: p.48).

In this quotation no mention has been made about the necessity of practical skills. Though it is impossible to guess what is in the mid of this participant one can understand from the responses that the emphasis is more on theoretical aspects than the practical skills.

5.3.4.3. Content as a Means of Achieving the Country's Objectives

For those who viewed engineering curriculum as "a means for full-filling the country's objectives", the perception of content seems to refer to selection. The focus, in this regard, is on selecting content and skills that would enable students to perform the pre-specified competencies and attain the goals set in the curriculum. This means, that student' learning of content by itself is not the focus of teaching and learning. Content learning has to contribute, support and develop the students' ability of solving problems through performing the competencies specified. Moreover, teachers who hold this view believe that teaching has to incorporate more practical activities than students' learning of content from the books but worried because of their inability to do that due to causal problems eminent in the institution. Let us see how such a problem is expressed by one of the participants of this study:

> *The condition, at present, is not suitable for providing more practical skills as we wish it to be. For instance the current population of students is not convenient, not comparable with the equipment and the practical working available. With the assumption of providing practical skills which is directly related to work, we have a program of internship for one semester. But it doesn't still meet out target* (N. 1: p.7).

In this regard more focus is needed on students' acquiring of more practical skills than that of the sciences and mathematics unlike the discussion expressed above. Another participant also expresses his worries as the following.

> *Of course, to be a good engineer one has to be in laboratories rather than in the classroom and be a theoretician. But due several constraints we are not capable of doing that. That is why our students are wasting more of their time in classrooms trying to understand theories* (N. 5: p. 88).

5.3.4.4. Content for Creating Engineers who are Critical Thinkers and Capable of Doing Things by Themselves

For those who view engineering curriculum as "a means for creating engineers who are critical thinkers and capable of doing things by themselves", content is seen as a means by which students become familiar with the available resources and possibilities that would enable them to tackle engineering problems and to have new insights during their learning. Such teachers are concerned to strike a balance between what a student wants and what industry needs. An attempt of such focus, on one hand, is an attempt of addressing the need for human resource development and on the other hand it instills confidence in the students themselves. So, the use of content in this sense is to build the knowledge and skill of the student so that he/she will do the work required and to be confident enough in what he/she has to do as an engineer. Let us see what a respondent of this study had to say in this regard:

> *Students want to fit into the realities of the work outside. Hence, they need more practical skill that makes them fit. On the other side industry needs graduates who have more practical orientation to do the job without expecting additional training. We, as teachers, also need to provide engineering education that is suitable for both students and industry. Anything we teach outside the need of the two parties mentioned is simply an academic exercise* (N. 4: p.70).

A prospective such as this one from the side of teachers entails their need for careful planning and selection of content to meet the demands of both students and industry and to build the confidence of the students as well. Seen together, engineering teachers, however, do not seem to embrace the modular arrangement of courses on the ground that the engineering education by itself has an interdisciplinary nature which calls for an interrupted teaching learning process which would be difficult for modular arrangement. Even though teachers have to implement modular arrangements in their courses it is not without resistance.

> *Even though this modular approach is ahead with other university level education, it is communicated to engineering or technology faculties of the schools of engineering, but the implementation is a little difficult, so there is resistance already (*N. 5: 84).

5.3.6. Teaching and Learning: The Interface between Engineering Education Curriculum and Engineering Education Practice

Teaching and learning in this study is taken as the interface between the intentions of the curriculum and the real practice of teachers and students at the institution level within the classroom or workshop situation as described by stakeholders. Hence, included in this part are the practice of teaching in ASTU, student’s learning, the practice of internship and assessment.

The term implementation is a common word that is always attached with the execution of a newly developed or a revised plan. The practice of curriculum implementation involves varied institutional settings, several hundred or more teachers in each of the institutions, and hundreds or thousands of students depending on the size of the educational setting where it is practiced.

There is no guarantee that institutional settings of the same level and the same status could implement the curriculum alike. Implementation of the same curriculum at different settings could yield different results in terms of, if not in quantity, but terms of the quality anticipated and sought in the curriculum document. The reason for the differences may come from different sources such as that of the condition of the physical setting of the institution into which the curriculum is executed, the capacity, motivation, and qualification of teachers involved in executing the curriculum, the availability and sufficiency of physical and material resources necessary for executing the curriculum, and the quality of leadership in the particular institutional setting.

The starting and the culminating point for implementing a curriculum, however, is the process known as teaching and learning which involves teachers at one side and students on the other side.

5.3.6.1. Engineering Teaching at ASTU

Teaching, expressed in terms of what the teacher does, take place either in classrooms or within the workshops or laboratories in the case of engineering. Likewise, learning, expressed in terms of what the students do, takes place in various locations, in addition to classrooms, workshops, or laboratories.

When we talk about the process of teaching and learning in this study, we refer to the interactions between the teacher and students and the material with or about which the communication is made. The teacher’s role within the teaching learning process includes the preparation and delivery of new ideas and materials that can assist student’s learning. On the other hand students are the ones who are expected to gain knowledge and skill from such communication. The successful implementation of any curriculum then presupposes the synchrony between these elements and results into what is called quality teaching and learning. Quality teaching in higher education matters for student learning outcomes. But fostering quality teaching presents higher education institutions with a range of challenges at time when curriculum keeps frequently changing and remains unstable as witnessed at ASTU.

As it has been pointed out in the preceding parts of this study, ASTU has experiences of frequent curriculum development practices that resulted in different curricula at different times within this short time range of the existence of engineering education in the institute. The execution and effectiveness of such curricula also depends on the agreement and synchrony between what is taught in the classrooms, laboratories, and workshops and what is known by the students. In other ways this refers to the congruency between what was planned and what is learned by the students.

The way teachers perceive curriculum and content affects their teaching and ultimately the students' learning. The teaching learning process in engineering education at ASTU refers to the teaching learning of courses arranged in modules. Engineering education includes different modules from different disciplines such as that of the humanities and social sciences, Business, and others, in addition to the major and related engineering discipline modules. While the teaching learning processes of the humanities and the social sciences, including business and the theoretical aspects of engineering modules mainly depend on the interaction between the teachers and students at classroom situation in the form of a lecture, the core modules of the engineering disciplines in most cases require the use of workshops and laboratories more than others.

Although the usefulness of other teaching strategies is being widely examined today, as pointed out by the participant of this study, the lecture still remains an important way to communicate with the large number of students (ranging from 70 to 80 students in a class) at ASTU. The traditional lecture method, if used in conjunction with active teaching strategies can be an effective way of teaching and to achieve instructional goals. However, engineering teachers at ASTU do not seem comfortable with the present arrangement of the class size for lecture method. For example, a response from one participant of this study points out the distress related to large class, as follows:

> *Teaching and learning is poor because of different constraints in materials and resources in general. Materials are not sufficient compared to the large number of students assigned in each group. The number of students in a lecture group is too many; 60 to 70 students per lecture class and 30 to 35 students per lab session. Seats in the classroom are not comfortable. Students in both lecture and lab sessions are very crowded, and hence, checking each student's work and progress is very difficult and tiresome, if not impossible* (N.2: p.29).

Another fellow teacher who is a participant of this study also iterates the problem associated with large group of students as follows:

> *The student population is too big. For instance, one lab group contains 40 students and one lecture group up to 70 to 80 students. You can not follow each student, even in the lab work because of the big size of student in a group and because of the shortage of the supply and equipment. … In addition to this, the attitude of the students is also very difficult to handle* (N.1: p.15).

From both of the above quotations it would be possible to understand what kind of teaching would exist in both lecture classes and in lab sessions of ASTU. It is not also difficult to guess what a classroom with 80 students would look like and the seat arrangement therein. It clearly suggests that there is a wide distance between the teacher and student in terms of what the teacher does to each student and in terms of what each student has to receive from the teacher. The points expressed by one of the interviewees in the quotation below, is an indicative of the situation into which teachers as teachers act and students as students learn. It is also an indicative of how assignments are used in the teaching learning processes. Assignments as a teaching learning process, as used in this case remains to be the work of the students alone that avoids the feedback element that has to be done by the teacher.

> *For instance, when I teach second and third year students, usually they are many in number, 60 to 65 in a class and sometimes 70. Even if I tried to give them assignments I hardly have time to correct the papers and evaluate them. I give them assignments often not to evaluate them but to make them work. My assumption in doing so is that they will study by the time they try to work the assignment. And finally, I collect the assignments; frankly speaking, I don't get time to correct all those 70 papers of each section. So, I have to pile them up in my room and at the end of the semester I have to throw it away* (N.3: p.51).

Teachers in the engineering education appreciate and believe in the use and the inevitability of the lecture method in the teaching learning process. But they think that the large number of students assigned in each of the lecture classes has slackened their relationship with their students, especially when they have to teach two or three groups of such a class. They give assignments to the students but they don't give any feedback to the students due to the large number of students they teach. In such a case teaching becomes like throwing whatever you have to students and there is no way that you know whether the student participates and learn in a meaningful way other than listening to what the teacher says and learning whatever material is provided to pass the examination. If we say that engineers have to have an ability of translating the knowledge and skill they have learned into solving a problem of practical nature, a heavy reliance on the traditional lecture method involving a large number of students would not result into having the kind of engineers one would like to have. As pointed out by Felder and Henriques (1995), students learn by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing. The nature of the lecture method of teaching usually deals more with one way communication and the imparting of knowledge aspect rather than translating knowledge into practice and applying it to problem solving.

Another method employed in the teaching learning process of engineering education at ASTU is project method. It is believed that the employment of this method would equip students with the ability and understanding of the process of planning and executing a project. As one of the participant teachers in this study puts it, the need for employing such practical method arises from the need of equipping students with what they need to meet at the final end.

> *Students want to fit to the realities of the world of work. Hence, they need more practical skill that makes them fit. On the other side industry needs graduates who have more practical orientation to do the job without expecting additional training. We, as teachers also need to provide engineering education that is suitable for both students and industry. Anything we teach outside the need of the two parties mentioned, it simply be an academic exercise which does not serve the immediate development need of human resource within the country* (N.4: p. 69).

The project method of teaching requires the teacher to prepare or design a project that has to be performed by the students within a certain period of time. Students have to work on a project that has relevance to the course they learn. It requires the use of workshop practices, materials, tools and equipments for its employment. The success of a project approach as teaching learning method in engineering education is highly dependent on the availability of the materials, tools and equipments, but it is not without challenges of its own within ASTU. Let us see what a participant of this study on the interview has to say with regard to this:

> *The condition, at present, is not suitable for providing more of practical skills as we wish it to be. For instance, the current population of students is not convenient (not comparable with the equipment available and the practical working space available* (N.1: p.7).

This sense of trepidation is shared by almost all the teachers who were participants in this study. To have more understanding of how problematic the situation is, let us see what another participant of this study had to say:

> *The students actually want to know how courses learned in theory could work in practice. However, due to the scarcity of resources occurring in the department, they have no option, rather than accepting the existing situation and continue with that* (N.7: p.142).

The possibility of creating practical oriented graduate largely depends on the students' involvement in repeated and varied practical work. For example, telling the step-by-step procedures of driving a car would give a theoretical knowledge, but it alone would not enable an individual to drive a car. If he/she had to drive a car, he/she has to practice it twice or three times or more. The inclination towards the provision of more theory with less practical tasks in the teaching learning process of ASTU has also been felt by students who were participants of a focus group discussion that was organized by this researcher. This reads as follows:

> *The teaching learning process is too theoretical; I don't think engineering has to be theoretical. But we are learning theory; this is one of the weaknesses of the teaching learning process* (FG1: p. 220).

Neither the teachers nor the students deny that the teaching learning is biased towards theory and this is contrary to what is indicated in all curricula documents defined under the auspices of ASTU so far (see for example, AU, 2007a: 5-7; AU, 2007b: 10). Let us also see what another focus group participant of this study had to say in the following quotation.

> *The other is laboratory problem; we didn't work many of the labs we were supposed to do; For example we did not work hydraulics lab; There is an existing soil lab, but on the reason of not having the accessories and materials it is not working; Even when there is the material and we are supposed to work the laboratory, due to the large number of students we cannot work the lab as it is supposed to be. At present we were supposed to work a lab (soil test) on highway course; but what happened was after we have taken about three classes, we were told simply to write a report*

and we did it. We did not perform the lab based on the procedure. Now, if I am asked about the test it is hard to say that I have the knowledge required (FG1: p.233).

5.3.6.2. Internship as a Teaching Mechanism

Internship, as one component, is part of the engineering curriculum at ASTU. Students who have completed their three years of study go out of campus for one semester internship practice within the industries available in the surrounding. Participants of this study, that is, both teachers and students including those interviewees from industry agree that internship as a teaching learning mechanism is an indispensible component for students' learning. All of them agree that internship would give students the opportunity to look into what is contained in the world of work and to have a feeling of practice within it. Some of the teachers, as well as students, also see the act of internship as an important means of filling the gap between what is provided within the campus study and what is prevailing in the actual practice of work situation. Nevertheless, it is not without problems of its own. As pointed out by some of the teachers one of the major problems is unavailability of industries that can accommodate all of the students legible for internship practice. Even if students are assigned on internship practice within an industry, at times it fails to meet the intention due to lack of proper supervision and follow-up from the side of the institution which from the side of teachers.

5.3.6.3. Assessment and Evaluation

Assessment in the engineering education of ASTU takes place in different ways and for different purposes. The dominant part of assessment until recently was the pencil and paper method where students are required to respond to teacher made questions in written forms. Participants in this study witness that continuous assessment has become mandatory more recently. While they appreciate the importance of continuous assessment ideally, they express that it is intertwined with full of problems. Much of the claim is related to the high number of students joining each of the departments every year and every semester. Neither the teachers nor the students at ASTU regard the practice of assessment as efficient and effective. Both teachers and students think that the assessment mechanism needs some kind of improvement.

The following statement of a department head who is a participant of this study shows the ill feeling that characterizes the feelings of many of the participant teachers who are involved in this study. “In conclusion I can’t say effective continuous assessment is conducted, but we are trying our best” (N. 6: 105). One of the most serious problem teachers raise here is the number of students in each group of class and the teachers’ involvement in teaching a number of group. Teachers are required to teach 12 credit hours per semester which means 12 hours class contact per week. For example, if we say that a teacher is involved in teaching a three credit hour course for different group of students, and if we say each group has 70 students, the number of students he/she would be dealing with would be 12 /3 x 70 = 280 students. As a teacher he/she has to teach 280 students, he/she is required to implement continuous assessment (as some indicated six times/semester/course) for each group, he/she has to prepare examinations, He/she is expected to mark all the examination papers and give feedback to all of the students.

Such conditions, as witnessed by the participant teachers, are practically difficult. As expressed by them, they are not left with any time to accomplish all these as required. Hence, a short way out is officially accepting everything and practically not doing it up to the requirement of the curriculum or not at all doing it. Let us see how this was expressed by a participant of this study, which is also shared by other participants as well:

> *I don’t think people are doing it (referring to assessment) well. Except speaking theoretically that we are practicing continuous assessment. Personally, it is not well done, because of the large number of students. We cannot evaluate their papers; you cannot see every student’s performance every time you come to class. It is not simple* (N. 9: p. 208).

Student assessment is the mechanism by which you gauge the student’s ability of knowledge and their ability of doing engineering tasks upon their graduation. A sub-standard teaching, as stated in this study elsewhere, accompanied, with a sub-standard assessment mechanism is obviously a threat for the quality of education, and subsequently on the quality of knowledge and skill graduate engineers acquire. None of the respondent teachers felt that they are practicing the assessment mechanisms specified in the curriculum document are practiced properly. The same ill-feeling of the assessment mechanism is also felt by the students. As witnessed by the students, both teachers and students are more exam oriented, which means teachers give examination just to fulfill the official requirements and students take examination just to pass. Suppose we see the following statements of students which were uttered on a focus group discussion, we can understand how quality is being threatened: We present three of them here for more understanding of the problem:

> *They (referring to teachers) try to examine what the students do not know. They target deliberately on what the students do not know; they are more concerned on the question of "what is that the students do not know" rather than what is known by the students. to my understanding the essence of an examination is what have I done to my students and what have the students gain from what I did to them; but what we see is just because he/she has mentioned a topic, he/she ends up to use it as an item for examination* (FG. 1: p. 285).

Though this was said in relation to some of the activities of some teachers, students are also critical of themselves in terms of how they react to examinations and tests:

> *I explain the teaching learning process as dependent on grade. If you say 'why?' when we come to teachers, teachers say to us "this portion will not be included in your examination; you don't have to read it. We as students do not want to read anything that may not be covered by the examination. In this university the major objective is obtaining grade rather than the acquisition of knowledge and skill* (FG. 1: p. 224, p. 225).

Students are also critical of the institution's management in connection to what teachers do in relation to their act of examination.

> *I don't think that the management is supervising teachers and check who is doing what; some teachers, after having class only two times they will examine us mid-semester examination; in the same way, after the mid-semester exam they teach us two times and examine us final examination. Since we students are grade oriented, we don't accuse the teacher and try why it is going like that, because we think that the teacher will punish us in grades (FG. 1: p. 226; p. 227).*

5.3.7. The Challenges of Engineering Curriculum Implementation in ASTU

In this part, the focus is on what participants frequently mentioned as challenge in their experience of teaching learning. Frequent curriculum revision, teacher quantity and quality, student population and budget and resources are referred to as challenges.

5.3.7.1. Frequent Curriculum Revision

Change is an inevitable phenomenon of everything. Nothing remains stagnant forever. So does the curriculum. But curriculum to be changed has to pass the test of practice and time. In the first place, curriculum change and implementation cannot and should not be a matter of an individual's or anyone's choice or preference. It requires the involvement of a number of stakeholders; policy makers, institutional leaders, teachers, students, and others who have their own stake to share and contribute towards its effectiveness. However, the repeated practice of revising the engineering curricula at ASTU has left the teachers and students with constant uncertainties and they put it among the major challenges. Almost all participants of this study expressed their concern that the frequent act of changing curricula has created uncomfortable situation for both students and teachers. An example of that concern which was uttered by a respondent reads as follows:

> *The frequent curricula change hinders teachers from being certain. Moreover, since teachers involve in curriculum revision activities, in many cases their time is occupied which otherwise could be used to improve their teaching methodologies and assessment activities* (N.3:p. 57).

Some of the teachers, as it has been mentioned in the preceding parts of this study, see the last curriculum as means for stopping the recurring activity of curriculum revision which was common in the last few years. Of course, the nature of engineering education in this era is changing fast due to the demands coming from diverse situation but not as fast as the changes of curriculum in ASTU.

5.3.7.2. Teacher Quantity and Quality

Many of the participant teachers in this study believe that their teaching is not up to standard and attribute that to the shortage of resources, the large number of students, and the poor academic backgrounds students have. But few of them were willing to look into themselves and say what they feel and do as teachers. A most appealing example of such an insight which is said by a participant teacher in this study, reads as follows:

> *A graduate engineer, just like me, will be paid about thirty thousand Ethiopian birr in the industry. Me, a graduate engineer, I am paid 3700 Birr as an experienced lecturer. Why should I waste my time in the institute teaching students? Rather, I should go to the industry and get thirty thousand Birr. What I mean is you know if you want to improve engineering education you have to*

> *improve the salary of engineers who are supposed to teach these candidate engineers. Otherwise, if you pay me little money I pay little time for students, because I have to work outside to earn more money* (N. 9: 2001)

Though this was said explicitly by this participant, which, may be a bit exaggerated, it appears to be true in other cases too. This is also evident in what students say with regard to the type of teaching they are receiving. Students who participated in the focus group discussion witness that many of the teachers do not appear in their every day class sessions and try to teach the subjects they are assigned to teach. According to these students a significant number of the teachers either get absent from classes, or even if they come to classes they do not teach the subjects up to the expectations. Since such occurrence is more visible on the teaching learning sessions of the core or major subjects, students felt that they are denied the right to finish the specified course elements properly. An expressive example of such discontent uttered by a focus group participant student reads as follows.

> *It cannot be said that the instructors are providing us the required education and skill as appropriate as per the requirements; the reason for this is what I stated previously; many of the instructors are working in the cities. For an instructor who has a class on Monday, no one can be sure for his appearance on Monday. A number of instructors are not teaching students as per the schedule. Due to this, it cannot be said that teachers are in the state of producing and delivering knowledge and skill that the student is supposed to get* (FG. 1: p.216).

Engineering knowledge, skill, and abilities, that is expected from anyone who has gone through engineering education comes partly as the result of what the teacher does in classrooms or in workshops during his/her teaching. Though students are inherently capable of constructing their own knowledge, skill and attitude, they need to have a professional support, guidance and facilitation of the teacher. On top of all the materials available in their surrounding within their institution, they need to be taught properly as per the requirements of the course outlines and course descriptions. But this seems to be highly jeopardized due to teacher absenteeism and this puts the quality of engineering education to be threatened.

Participant students also raised the problem of some teacher qualification and their incapability of teaching the subjects in relation to its practical application. According to the students what they are being taught is more of theory rather than theory in association with practice. The following statement of a participant student is an indicative of the experiences students have:

> *The teaching learning process is too theoretical; I don't think engineering has to be theoretical. But we are learning theory; this is then one of the weaknesses of the teaching learning process; the other is the incapability of many of the teachers in practical work. In fact, students are not the examiners of teachers. There is a legal body responsible for that, but they are also affected by flow of the tradition of teaching and learning. He said in Amharic* "c፡¨ `É c፡ª [É ¾S× ¾ST` Te*ƒ* T` ዞዷ*ƒ*" (FG. 1: 220).

Upon further quest for more explanation on what he meant by this, he explained what he meant by this as the following: "The teachers previously learned theory without the support of laboratory and related practical experiences and then they are teaching us without the support of laboratories just as they were taught previously" (FG. 1: 221).

Even though the majority of the participant teachers in this study attribute the problem of teaching to factors such as shortage of resources and to the large number of students they teach at each session, teacher absenteeism coupled with improper execution of teaching has become a threat to the quality of engineering education at ASTU. If ASTUs vision of becoming of "a first choice in Ethiopia" has to be realized and if it has to accomplish its mission as planned properly, paying a closer attention to such problems and solving it as early as possible seems to be an inevitable task awaiting.

5.3.7.3. Student Population

The class size for the first year lecture classes is stipulated to be 60 to 80 in ASTU. (Senate Legislation, 2012: 171). Likewise the lecture class size for second year and above is indicated to be 50 to 65. Class sizes for tutorial and lab teaching is also pointed out to be 30-40 and 20-30 respectively. This is not different from the number that is pointed out by the participants of this study in reality. But they thing that teaching so many students in a class and dealing with many groups of such a class leaves the teacher to run out of time for his/her preparation and for providing feedback to students regarding their group work and individual assignments and other works. Such an ill-feeling of teachers is manifested not only in connection with their teaching but also with their duty of student assessment. The following statement said by one of the participant of this study shows what it looks like:

> *I have no time to practice continuous assessment, I have no time just to offer them project and I have no time just to evaluate it. This means we are not properly assessing or evaluating students, because their number is so large. We have no time even to prepare for the course to offer a lecture in class* (No. 9:2007).

The problem with high number of students was also a concern of the participant students in this study. They feel that the size of their number in both classrooms and in workshops has an effect on their learning. One example of such worry by the students reads as follows:

> *This school is accepting students beyond its capacity. Now 20 students learn on a table that was originally made for 2 students. When it was a technical school 2 students were doing on a table, but now we are using it for 20 students. Now we use one model for 20. In this, one of the students gets grip of it and touches it and looks how it works, the 19 of us simply stand around and watch* (FG. 1: 240).

The focus in creating more access for engineering education is with no doubt important for this country and many people would agree on this. But this also has to produce engineers who have the capacity and ability to fulfill the needs of the country. If it becomes a threat to the quality of education, as pointed out by the teachers and students, it is likely that it needs some mechanism of improving in one way or another.

5.2.7.4. Shortage of Resources for Teaching and Learning

Almost all participants of the study mentioned that there is lack of recourses of different kinds including classrooms, laboratories and workshops. Almost all of them believed that the curriculum, as it is planned and implemented, could result better than what it is doing currently, had there been sufficient and relevant resources and everything is in place as per the requirements. None of the participant teachers and students has skipped mentioning the problems that prevail in the system and how such problems or shortage of resources affected the teaching and learning problems more than anything else. This was expressed by one of participant teachers as follows:

> *Teaching learning is poor, because of the different constraints in materials and resources in general. Materials are not sufficient compared to the number of the student population assigned in each group. The number of students in the lecture group is too many, 60 to 70 students per lecture*

> *class and 30 to 35 students per lab sessions, seats in the classroom are not comfortable. Students in both lecture and laboratories are very crowded, and hence, checking each student's work and progress is very difficult* (N.2: p. 29).

The shortage of resources is not evident only in the physical resources such as that of shortage of laboratories. The unavailability of well qualified teachers, coupled with the absenteeism of the existing teachers from their teaching classes, can be regarded as the significant challenges within ASTU.

CHAPTER SIX

BAHIR DAR INSTITUTE OF TECHNOLOGY (BiT)

6.1. Introduction

This chapter deals with the third case, Bahir Dar Institute of Technology (BiT) as part of the overall case study of the curriculum development process of engineering education program in Ethiopia. Themes and the respective categories used in chapters Four and Five are used as the bases for the analysis and presentation of the empirical results, in the Chapter.

6.2. The Institute as a Context of Engineering Curriculum Implementation

This part is concerned with the location of the institute including programs and student population, experience prior engineering the curriculum reform, and the engineering curriculum reform within BiT.

6.2.1. Location, Programs and Student Population

BiT is situated in Bahir Dar city which is the capital city of the Amhara Regional State. The present BiT, in the past, provided technical education at different levels and has undergone through different status. It began as a technical school in 1963 (Fantahun, 2013) then developed to the level of college in 1968 and finally combined with the former Bahir Dar Teachers College to form Bahir Dar University in the year 2000. Currently BiT is one of the technology institutes which are part of the Bahir Dar University. Physically, BiT is situated outside the main campus of the university.

Bahir Dar city, into which BiT is found, is located approximately 553 kilometers away from Addis Ababa in the Northern direction. The city is recognized by UNESCO (2002) as one of the leading tourist destination in Ethiopia and was awarded the UNESCO Cities for Peace Prize in 2002 on the occasion held at Marrakesh.

Bahir Dar University is now regarded as being among the largest universities in the Federal Democratic Republic of Ethiopia (Bahirdar University, 2011: 9) with more than 35,000 students in its 57 undergraduate and 39 graduate programs. Bahir Dar University has four colleges, three institutes, three faculties and one school. The academic units of the University include College of Science, College of Agriculture and Environmental Sciences, College of Medical and Health Sciences, College of Business and Economics, Institute of Technology, Institute of Textile, Garment and Fashion Design, Institute of Land Administration, Blue Nile Water Institute, Faculty of Humanities, Faculty of Social Sciences, Faculty of Education and Behavioral Sciences and School of Law.

BiT, as an institute, is structured under four schools of: Chemical and Food Engineering, Civil and Water Resource Engineering, Computing and Electrical Engineering, and Mechanical and Industrial Engineering. As per the Academic Affairs Office of Bahir Dar Institute of Technology (2013), BiT caters a total of 9815 students, of whom 2375 are females.

6.2.2. Experience Prior Engineering Reform: Bahir Dar Faculty of Technology (BDU)

The present Bahir Dar Institute of Technology (BiT) has a history of its own that goes back to 1963 and that began as a Technical High School. It was established under the technical cooperation between the then Government of USSR and the Imperial Government of Ethiopia in 1963 (Fantahun, 2013). Because of the involvement of many Russians, especially at the initial stage, in its construction and training activities, it was sometimes called as the “Moscov School” by the local people.

At its beginning, that is in 1963, as a Technical School, it used to accept students who had successfully completed eighths grade and who were drawn from the different parts of the country. The fields of studies included in the curriculum, at that time were Agro-Mechanics, Electrical Technology, Industrial Chemistry, Textile Technology and Wood Technology. The time required to finish the training in these fields of studies was a total of four years. During this time almost all of the courses in the major areas were taught by Russians where as the general courses, such as those of Amharic, English, Mathematics, Physics, and History were taught by Ethiopians and Indians.

But within the subsequent year, in 1964 the school changed its admission requirements from that of the previous year and accepted students who successfully completed their tenth grade and who had high scores in subjects such as physics, English, Mathematics, and Chemistry. The school was also renamed as Polytechnic Institute (PTI) in the same year. In spite of raising the admission requirement, the time required for training remained to be the same four years as it was in the previous year, Moreover, in this changed provision of education students were made to choose their field of specialization after the successful completion of their first year studies. The remaining three years were devoted to intensive training in each of the specialized fields of study.

However, in the year 1968 the four-year program was again phased out and in its place a two year college level program was launched for students who had completed 12^{th} grade. Admission requirements were also changed and based on the passing of the entrance examination that was provided by the institute to students who completed their secondary education and who passed the Ethiopian School Leaving Certificate (ESLCE). These were selected from all of the high schools within the country. However, the two programs, that is, the program which based its requirements on completion of grade ten and the program which based its admission requirement on the completion of grade 12 were run side by side until 1972. The first college level graduates received their diplomas in the year 1970. It was again upgraded to the level of a degree providing institute starting 1997 and continued in that status until it was merged with “Bahir Dar Pedagogical College” in 2000 to form Bahir Dar University. By the time the engineering education reform was begun, the present BiT was part of Baher Dar University with the status of School.

As a Technical School and as a Poly Technique Institute, it was administered by the MoE for more than one and half decade until it was finally handed over to the Commission for Higher Education (CHE) in 1979 and became part of the higher education system.

6.2.3. Engineering Curriculum Reform in BIT

The root for initiating engineering curriculum reform at BiT was not different from the other engineering institutions included in this study. It emanated from the ECBP engineering initiative. BiT, as it is now, did not exist then. It received the present status of an institute as one of the results of the overall engineering education reform. At the beginning of the reform it was one of the Faculties of Bahir Dar University designated as Faculty of Engineering. Neither the teachers of the faculty or the leaders in the institute were not the initiators of engineering curriculum reform. They have been informed by representatives from the MoE that engineering curriculum is necessary and that change was needed in this regard. As pointed out by the participants in this study they did not waste time to accept the idea and to involve in the reform activities.

6.3. The Engineering Curriculum Development Process

This part refers to policy initiatives, curriculum development process within BiT, and Teachers participation in curriculum development process.

6.3.1. Policy Initiative

Since the starting point for the recent reform of engineering education in Ethiopia, in general, was the ECBP, the curriculum reform deliberations in each of the three engineering education institutions (included in this study) trace back their reform history to ECBP. As it was pointed out in Chapters 4 and 5, of this study, the engineering curriculum development process was based on and guided by the framework provided by ECBP. The engineering education curriculum development process in BiT, like the other two engineering education institutions, was performed by curriculum reform committees established within the institution that made use of the advices of the senior staffs of Addis Ababa University.

6.3.2. The Curriculum Development Process within BIT

As pointed out herein above, the initiative that led the reform came from a source that was outside the institute. It was not from within, either by the teachers or by the leaders of the institute. The ECBP curriculum reform initiative was accepted enthusiastically by almost all of the engineering education staffs BiT (then BDU) from the beginning. The experience of providing engineering education was not new for the staffs in the faculty like it was in AAiT (Chapter 4). Or they nether have a long experience as in the case of ASTU (Chapter 6). The length of their experience in providing engineering education lies somewhere in between, that is, they started teaching engineering in the year 2000. They did not accept the initiative as a fresh ambitious group like it was in ASTU or with challenging arguments like it was in the case of AAiT. They accepted it without any hesitation.

Soon after they were informed the ideas of the reform by the representatives from MoE, as pointed out by one participant of this study, they reacted positively and started to do what they have to do as per the demands and ideas of the reform which was provided to them as pointed out by one of the participants of this study herein below:

> *That was really very acceptable by the staff and very much interested by the idea of what has been told by the representatives of the MoE for the first time. Every one of us was so fast to involve in the activities of change. Soon after, we did a survey of demand that included employers, teachers, workers, and students and we managed to produce a draft curriculum in relatively short time* (N. 24: p. 448).

Their positive response to the reform ideas might have emanated from two sources, as far as this researcher is concerned. The first of these might have come from the need of the staff to receive a special and particular attention as engineering educators and to improve their fields of studies in the way they would like it to be. Secondly, it might also be from their prior information and understanding of the direction of the engineering reform within the country. Whatsoever may be the case, they soon involved in surveying of the needs to start curriculum development by establishing committees peculiar to each of the fields of studies. They made use of the advice of one senior academic staff member from Addis Ababa University for each of the fields of studies (see, for example, Study programs of Mechanical Engineering (2007), Electrical and Computer Engineering (2007), and Civil Engineering (2007). As pointed out by the participants, their survey result indicated that the former graduates of the institute lacked practical skills and that graduates were not real problem solvers. On top of this primary information, they also made use of the already existing curriculum as one of base for reforming the curriculum. Through such process, they managed to produce a draft curriculum. And then the draft curriculum was made available for comments and suggestions of different stakeholders such as teachers and students including industry. Different workshops and meetings were used as a forum for collecting the feedbacks and the suggestions from different people at different levels within the faculty and at the level of the university.

6.3.3. Teachers Participation in Curriculum Development

As pointed out herein above, the initiative that led the reform came from a source that was outside the institute. It was not from within, either by the teachers or by the leaders of the institute. Therefore, before and during the actual process of curriculum development, teachers were invited by the ECBP to involve in a number of workshops and to learn the directions of the change and the actual substance that had to form the actual or the new engineering curriculum. Much of their involvement in the curriculum development process was guided by the directives they received from the ECBP as pointed out by one of the participants of this study herein below:

> *I have participated in the ECBP curriculum development workshops. They gave us training on what is meant by ECTS (European Credit Transfer System) and how to determine it. How much credit should a student take in each semester, how we can calculate the weight of each course and to determine the ECTS for each of the courses* (N.23: p. 436).

From what has been said herein above, one can see and understand that the teachers in AiT had to learn what was proposed by the ECBP and accommodate it within their curriculum. Even though they have performed a survey of the needs at the local level, and managed to identify the shortcomings prevailing within the previous curriculum, the core orientation that guided the whole curriculum was the one which was suggested by the ECBP. The teacher's role in this case was limited to that of accepting the suggestions and work in line with it rather than deciding by themselves on what the curriculum should contain and how it should be framed.

6.4. The Content of Engineering Curriculum

Engineering curriculum, like any curriculum used at any level of teaching learning is an indicative of what teachers as teachers and students as students do in the teaching learning process. It informs both teachers and students on what to concentrate and what to do in that endeavor of teaching and learning. Included in this part of the study are the expectations pointed out within the curriculum seen against what is practiced at the institution level.

6.4.1. Curriculum Expectations

As it has been pointed out in Chapter 5 the way teachers perceive curriculum entails a difference on the type of content they select to teach their students and the methods they use in their teaching of engineering subjects. In analyzing the curricula documents in BiT, the content of engineering education is organized to provide "broad based education" (BDU, Mech. Eng., 2007: 3), "to give more emphasis to practical aspect of engineering" (BDU, Elec. Eng. 2007: 4) to offer a B. Sc. Program covering all important branches and disciplines" (BDU, Civil Eng., 2007: 4).

Though the expectations of the different curricula, as has been seen here, are expressed in different ways, an in-depth examination of their contents shows: that they all are structured in modular forms, that they all included internship practice as mandatory, that they all require five years of study, and have more of similar features with regard to their structures than differences.

Statement in all of the curricula documents express that students at the end of their education have to have knowledge and skill that satisfies the need of industry, have entrepreneurial and managerial skills, and they all need their students to apply knowledge of mathematics, science and engineering, design and conduct experiments, as well as ability to analyze and interpret data, function on multi-disciplinary teams, identify, formulate, analyze, and solve engineering problems, including ability to communicate effectively and understanding of professional and ethical responsibility in the students. The following structure of Mechanical Engineering curriculum is an example of how the curricula were structured.

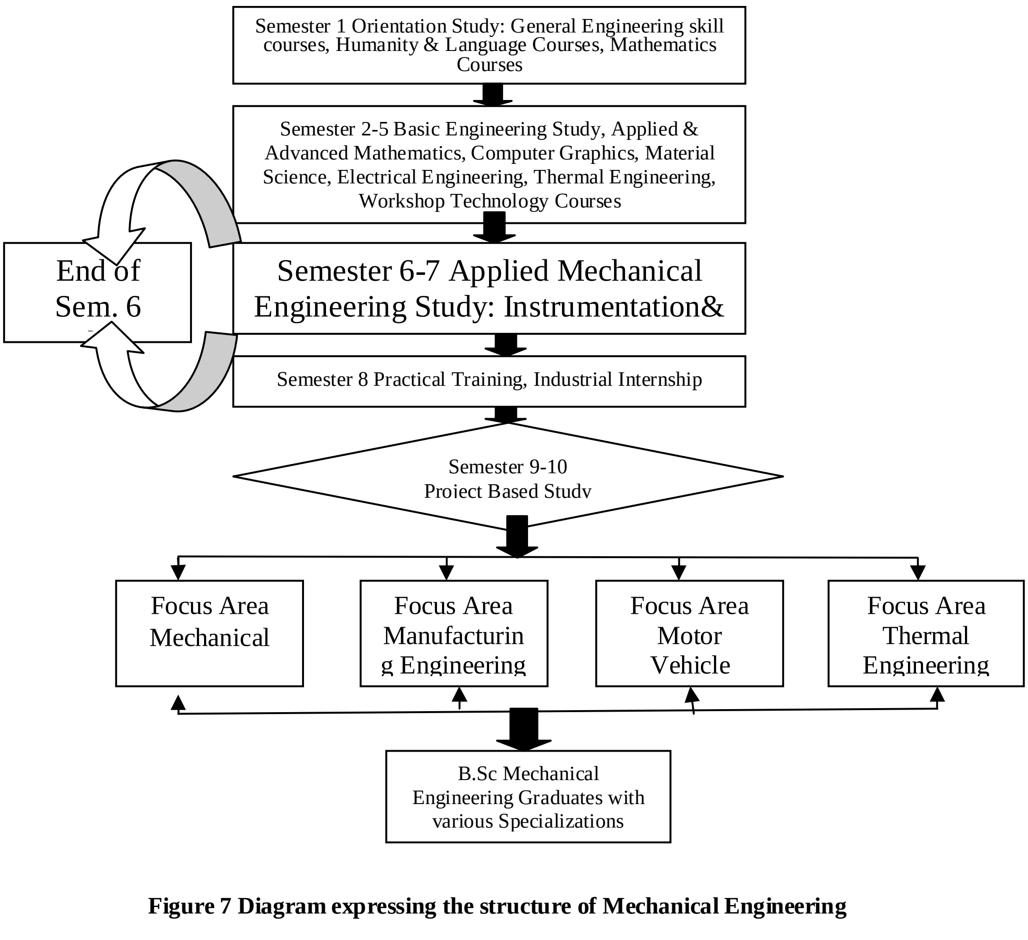


Figure 7 Diagram expressing the structure of Mechanical Engineering

Source: Department of Mechanical Engineering, Bahirdar University (2007, p. 15)

Courses that are used to realize such expectations are arranged in modules such as that of General Engineering Skill Module, Basic Science Modules such as Applied Mathematics and Advanced Mathematics Modules, Humanities and Language Module, Communication and Entrepreneurship Module, Core Engineering Sciences Modules such as Machine Drawing and Computer Graphics, Engineering Mechanics, Mechanics of Materials, Advanced Engineering Mechanics Supportive Engineering Sciences Modules such as Material Science and Electrical Engineering Modules can be cited as examples. More specifically, the curricula documents suggest that content of engineering education is defined in relation to the competencies identified to enable engineering students to understand and be able to do the things they have to do. This means that the content of engineering education has to focus mainly and be structured around knowledge and skill bases that would enable the students to apply them to a pre-specified ends. This, in the context of this study, means the knowledge and skill that is learned by the students has to be able to create their graduate profile as specified by the curriculum; not as they would like it to be.

This, however, does not mean that all the content specified in the curriculum does not contribute to what the students would like to be. The mathematical and engineering sciences provided to engineers come from the same root wherever the country may be. What varies most is the degree of concentration and the way it is provided, that is, the availability of materials, the qualification of teachers, the technology used for teaching, and the commitment of the leadership in introducing and enforcing quality boosting ideas.

6.5. Perceptions of the Field of Engineering Education and Curriculum

As has been indicated in the case of ASTU, in Chapter Five, different teachers and or students perceive engineering education and engineering curriculum in different ways. The major concern, in all cases, however, is the production of the best engineers that can provide the best services of engineering. Their differences mainly emanate from the degree of the emphasis they put on the theoretical aspect or on the practical skills of engineering. For some of the teachers engineering education at the undergraduate level should focus more on the engineering sciences and related mathematics and analytical skills in these areas. For some others, the most important thing in engineering education is the acquisition of engineering skills associated with the solving of practical problems together with relatively enough knowledge of engineering sciences and related mathematics. Teachers in BiT are not different in this regard. For instance, one of the participants in this study describes engineering education as follows:

> *Engineering education is a field of study which focuses on solving of problems and it is a field that enables individuals to create new things that would help the society. It is always related to solving engineering problems, which are prevailing within the society, and it strives for the betterment of human life* (N.26: p 407).

What we see in this quotation is the emphasis on solving of problems which implies an inclination towards the practical. Nevertheless, higher emphasis on the theoretical alone is not favored by any of the teachers. This can be understood from what one participant of this study says in the following:

> *The strength of the reformed curriculum is its emphasis on laboratory. But the fact that it gives a chance for students to pass their examination without much knowledge of the theoretical aspect, because even if a student gets 0 in the theoretical examinations, he/she can score a passing mark by doing the practical aspects only* (N. 23: p. 442).

6.6. Teaching and Learning: The interface Between Engineering Education Curriculum and Engineering Education Practice.

Included in this part are engineering teaching in BiT, and the assessment mechanism together with a brief description of the overall challenges.

6.6.1. Engineering Teaching in BIT

As pointed out in the curricular documents of BiT methods in the teaching of engineering include: classroom lectures backed by course-work projects, tutorials and assignments; workshop practice and laboratory experiments and design assignments, presentations; industrial visits, demonstrations, simulation and industry internship (BDU, Mech. Eng, 2007: 27; BDU, Civil Eng. 2007: 15; BDU, Electrical eng. 2007: 13).

Research findings in the different methods of teaching and learning in other situations indicate that the successful application of individual or mixed methods of teaching such as those indicated in BiT curricular documents depends on the existence of other variables such as those of the conditions of classrooms, laboratories, and workshops, teacher preparedness and skill, availability of materials, student motivation, and others.

As we all know the teacher's role within the teaching learning process includes the preparation and delivery of new ideas and materials that can assist student's learning. On the other hand students are the ones who are expected to gain knowledge and skill from such material and communication. The successful implementation of any curriculum then presupposes the availability of the various variables pointed out herein above and the synchrony between these elements to result in what is called quality teaching and learning. Quality teaching in higher education matters for student learning outcomes. But fostering quality teaching can be threatened when the bondage between those variables is loosely structured and incompatibility exists.

It has been indicated time and again in this study that the way teachers perceive curriculum and content affects their teaching of engineering education and ultimately the students' learning in terms of what they know and be able to. The teaching learning process in engineering education at BiT, like in the engineering education institutions which are dealt with in this study, refers to the teaching learning of different courses arranged in modules. Different modules such as that of the humanities and social sciences, Business, and others, in addition to the major and related engineering discipline form the content of engineering education in BiT.

Most of the core modules in engineering teaching and learning require the use of laboratories and well equipped workshops and materials in addition to classrooms. The availability or unavailability of such things in sufficient quantity to the number of students facilitates or hampers students' in many ways. As pointed out by teacher participants of this study:

> *Active teaching-learning is not practiced well. The first thing we don't have books, shortage of instructors & the existing ones are overloaded. We don't have laboratories even classrooms. In*

our school we have 2000 students. To give feedback of assignments is not possible with much student number. To make the class in the mode of active teaching-learning is unthinkable these days (N.23: p. 443).

6.6.2. Student Assessment and Evaluation

Curricular documents in BiT indicate that any student to be assessed has to fulfill the attendance requirements as stated in the following:

At the end of each semester, the student sits for final examinations of the courses he/she has attended (minimum 75% for lectures and tutorials, 100% for practical exercises). A student must pass the examinations for all the courses in addition to the Holistic Examination at the end of the sixth semester (BDU, Elec. Eng. 2007: 13).

In BiT there is no evidence of providing what is called "holistic" examination. As can be seen here, a student to be legible for examination he/she has to attend lectures for about three quarters of the time set for it and full time participation for practical exercises. Irrespective of attending classes and performing the tasks set for practical exercises the actual student assessment at BiT involves written and mid, final examination including assignments for the theoretical part of learning and assignments, quizzes, project (in some cases) for work that includes laboratory experiments and workshop practices.

One important point worth to note here is that assessment in BiT is more focused in what is called activities such as tutorial, group and individual assignments and the like. Such activities and tutorials, as indicated by one participant of this study, involve at least three assignments, and about five quizzes which has high value in determining the students' scoring of grades and passing the exam in the end. This means, if a student scores high marks in practical activities and scores a very least mark in the mid and final examinations, it is likely that the student would obtain not only a passing grade but also better than that.

Though this is the working condition of assessment, both teachers and students recognize that there is somehow a problem in this kind of assessment mechanism. For instance, one of the participant teachers in this study indicates the weakness of giving emphasis to assignments and laboratory work as follows:

> It (referring to assignments and laboratory work) gives a chance to students to pass their examination without having the knowledge of the theoretical aspect, because even if he/she scores 0 in the theoretical examination, they can pass with the results of the practical. It misbalances the theory with practical (N. 23: p.442).

This is also observed by the focus group discussion participant students in a more or less similar way to that of teachers. An example of this is as follows:

> Assessment is performed on day-to-day bases. Since 60% of the score has to come from assignments and some lab activities more concentration is given to it. You learn to satisfy that rather than being concerned about the theoretical knowledge and the principles underlying those practices (FG3: p. 456).

From the responses of the participants in this study one can understand that the assessment mechanism do not seem to satisfy both teachers and students. Nevertheless, neither the teachers nor the students have the power to put it in another way other than accepting it and performing it as it is suggested in the curriculum document and in other curricular guides. However, had there been a real commitment for the teaching profession and had there not been dissatisfaction with rewards they are receiving from their services of teaching, compared to what the market pays to engineers at their level, probably teachers could have done something better than they are doing now.

Suggestions of curricula with regard to assessment such as those of employing a holistic examination, just in the same way as that of discussed in the two preceding chapters, remain unresolved or unemployed in the sense it is suggested.

Curriculum evaluation, like it has been mentioned in the chapters that proceed, is not a common word, at least in the engineering curricula documents used for this study, in the sense it is found in many curriculum text books. Common in the documents is the term “quality assurance” (BDU, Mech. Eng. 2007: 29; BDU, Elec. Eng. 2007: 14) which is directly connected with the quality of the program.

6.7. Challenges of Engineering Curriculum Implementation at BIT

BiT, like the other cases described in this study, faces a number of challenges like that of lack of qualified teachers, shortage of materials (in some cases shortage of machineries), shortage of laboratory equipments and laboratories including insufficiency of classrooms unavailability of books within the libraries, and others are among the pressing needs. As pointed out by the participant teachers and students, problems related to resources are more problematic for the teaching learning process of engineering in BiT than it is with the curriculum with the problem of curriculum. In fact the idea of "modularization" is also regarded as one of the challenges by some teachers.

6.7.1. Teacher Quantity and Quality

As pointed out by the teachers as well as students of BiT, unavailability of teachers in sufficient number and quality is one of the most pressing problems in BiT. This situation coupled with other teaching learning resource shortages are thought to be hindrances for practicing active teaching and learning methods. The shortage in the number of teachers, in one way or another, is associated with the large number of students. The following statement which was said by one of the deans at BiT is expressive of this situation.

> *Active learning is not practiced well. In the first thing we don't have enough books in the libraries. There is shortage of instructors and the existing ones are overloaded. We don't have laboratories, even in some cases classrooms. In our school we have 2000 student. To give feedback of assignments is not possible with big number of students. To make the class in the mode of active learning is unthinkable these days* (N.23: p. 443).

The problem connected to the way how they approach their teaching profession is also expressed as the following by students.

> What constrains us this time is what is called "student-centered teaching and learning". For instance, the teacher comes with his LCD(referring to the electronic projecting tool), reads it in the class and he/she goes out. Suppose we don't understand it and ask him/her some questions, he/she says 'my duty is to give you some hints; the rest is yours (FG3, p. 459).

From these two expressions one can understand how serious the problem is. On one hand there is shortage in the number of teachers. Even if there are teachers, they are not teaching to the level expected by students. On the other hand, in some cases, the idea of "student-centered teaching learning" is used as an excuse for teachers' inappropriate approach of their work.

Students also describe teachers as they are lacking practical experiences that would enable them to teach portions of lessons that include practical activity. One statement that is expressive of this idea is indicated herein below:

> Teachers do not have practical experience. They are not practically competent; because they did not work practical thing outside. They read manuals and try to teach us from that. In most cases courses of practical nature are being turned to theory. Teachers have to go out and see what is there in the factories. This lack of practical experience is also the same with the lab assistants. They don't know much, but they are assigned to teach us in the lab sessions (FG3: p. 467).

6.7.2. Student Population

Teachers as well as students of BiT consider the existence of large number of students within each session of classes and or laboratories, as a challenge for implementing the curriculum. According to such participants, the intention or the standards set for the number of students in a class and laboratories was different from what is practiced now on the ground. For instance, one of the participants of the study stipulates his ideas in relation to what he called "an orientation course" (Introduction to Engineering Skill (GEng-1001)), which was intended to "enable students understand the constructive interrelation of natural & social sciences as well as business and art to engineering and their positive impact on the socioeconomic aspect of a society" (Department of Electrical Engineering 2007: 33), as follows:

> It was intended to provide some skill practices with this course assuming that the number of students within a class would be as set by the curriculum, which is, 50 students per class. But the reality on the ground shows that the number of the students in a class is well above that. Hence, the teaching of the course did not go well as it was originally intended (N.23: p. 441).

According to this participant, the intention with this course was to practically orient students with the different fields of engineering by taking and teaching them within the different laboratories established for the practices of the different engineering fields of studies. But as a result of the large number of students was not possible to teach the course as it was intended.

6.7.3. Shortage of Resources

Teachers as well as students in BiT indicate that there is shortage of teaching-learning resources which can be expressed in terms of material and human resources. While shortage of classrooms and laboratories, shortage of laboratory machineries and equipments fall into shortage of physical resources, lack of qualified and committed teachers that would tech as per the requirements of the curriculum fall into shortage of human resources. With regard to shortages material teachers indicate that there is shortage of different resources. As a result, employing active teaching and learning methods in a classroom situation and in laboratory sessions became too difficult.

> *Active teaching and learning is not practiced well. In the first place we don't have enough books for the students. There is also shortage of instructors and the existing ones are overloaded. We also don't have laboratories, even classrooms* (N. 23: p. 443)

This expression of the participant teacher was also shared by the students who were involved on the focus group discussion.

> …on the other hand, when we go to the library, there is no book. In some departments there are only three for 180 students (e.g. Electrical Engineering). In the relatively better departments handouts are provided (e.g. Civil Engineering) (FG3: 460).

This clearly shows the limitations of BIT in terms of both material and human resources and the prevailing of such a case has become the source of worry for both teachers and students.

CHAPTER SEVEN

CROSS-CASE ANALYSIS AND DISCUSSION

7.1. Introduction

In the preceding chapters of this study this researcher has presented the policies, perspectives and issues that shaped engineering curriculum development in Ethiopia and its implementation within three selected higher education engineering and technology institutions. The main concerns of policy, policy guides, and issues that contributed to and shaped the education reform in Ethiopia in general and those related to higher education in particular, including the reform in engineering education, are presented in Chapter One of this study. Chapter Two dealt with the review of related literature focusing on the concepts, nature of curriculum and curriculum development of higher education and engineering education. This chapter also included a brief description of the development of education in Ethiopia as a milieu for engineering curriculum development process. Finally, Chapters Four, Five, and Six, focused separately on three case studies into which the reformed engineering education curriculum is implemented and experienced by engineering teachers and students. The chapters dealt with the presentation of the results of the empirical data collected from the teachers, students, and other stakeholders.

What is presented in this chapter is a cross-case analysis which draws on evidence from the literature, the context of education in Ethiopia and from each of the case studies presented in Chapters Four, Five and Six. The cross-case analysis in the chapter is then organized around the five broad themes emerged from the analysis of the data presented in the preceding chapters.

7.2. The Institute as a Context of Engineering Curriculum Implementation

Analysis under this theme involved geographic location, experiences of the institutions prior to the engineering curriculum reform, and the idea of engineering curriculum reform within the three engineering education institutions. The findings revealed that the three institutions had different experiences with regard to the provision of engineering education prior the engineering curriculum reform. While AAiT and BiT have prior experiences in providing engineering education prior to the engineering curriculum reform, ASTU, on the other hand, was just a beginner during the start of the engineering curriculum reform. ASTU as an institution has experienced frequent curriculum changes that concerned both teachers and students more than it concerned the teachers and students of the other two cases in this study. Curriculum research in general shows and suggests that collectively shared guiding vision provides a strong foundation for comprehensive curriculum review process (Oliver and Hyun, 2011) which is lacking in this case. Morgan and Houghton (2011) think that “inclusive curriculum design benefits both staff and students when it is based on principles of equity, collaboration, flexibility and accountability” (Morgan and Houghton 2011: 5). The analysis, however, has shown that the initiative for the reform did not emanate from any of the institutions under this study. The reform initiative was totally alien to all of the institutions and belonged to the ECBP, which was functioning under the leadership of MoCB at the beginning. Curriculum change has to influence institutional practices in terms of its “depth” and its “pervasiveness” (Lattuca & Stark 2009). This was discussed in more depth in chapter two of this study (see pp. 35-38).

However, the role played by each of the institutions varied significantly once the initiative was introduced to the institutions. The teaching staff in AAiT (as part of the former Faculty of Technology) took the lead in participating in the engineering curriculum reform activities right from the beginning of the initiative due to their long year of experiences in providing engineering education and due to their better qualification, capacity, and ability. Hence, the curriculum reform activities of each of the institutions have taken different departure. While AAiT's curriculum development process was performed with close support and advice of the German professors employed by the ECBP, more of the activities of curriculum reform in other institutions were developed based on the curriculum structure of the AAiT. In most of these cases the staff in AAiT served as external advisors during the curriculum development process. Basically, all public and regional universities "depend considerably on graduates of the AAU" **(**Cordier, 2007: 36), (also see the curricula documents of BiT: Study Program for the Degree of Bachelor of Science (B.Sc.) in Mechanical Engineering (2007: 1), Study Program for the Degree of Bachelor of Science (B.Sc.) in Electrical and Computer Engineering (2007: 1) and, Study Program for the Degree of Bachelor of Science (B.Sc.) in Civil Engineering (2007: 2). However, both of the institutions, in their part, have conducted needs assessment to adjust to the ECBP curriculum framework and to come up with a curriculum they thought to be appropriate to students and relevant to the knowledge and skill requirements in the industry.

7.3. Perceptions of the Field of Engineering Education and Engineering Curriculum

The findings of this study revealed that engineering teachers perceived engineering education and/or engineering curriculum in different ways. None of these perceptions, however, are not different from what is known and what is perceived about engineering profession, engineering education, and/or engineering curriculum in general (see for example (Karseth 2006). Perceptions of the engineering profession, engineering education, and/or engineering curriculum usually differ on the emphasis one places on the different aspects of the engineering profession. As revealed in this study some of the perceptions emphasized more on the acquisition of knowledge in engineering sciences and the related mathematics and curriculum as a means for reflecting this reality for students' learning. Others considered engineering education as means for solving practical problems based on the theoretical principles and the curriculum has to reflect both the theoretical and practical aspects for students' learning.

Engineering profession by its nature calls for the use of different theoretical bases from different disciplines and it involves practice that translates these theoretical bases of the different disciplines into something useful and tangible output. So the reasons for the differences in perceptions of the teachers emanate from ones emphasis on either the theoretical bases of engineering or on the practical aspects (example, Felder, (2012), Dym, et al. (2005); Crawley, et al. (2008). According to Felder (2012) the difference emanate from "two approaches to knowledge, learning, and teaching" (Felder 2012: 2). These approaches, as pointed out by Felder (2012) are the traditional paradigm, which has dominated engineering education since its inception, and the emerging alternative that offers predictions about the eventual resolution. On the other hand, an examination of the curricular documents of all institutions and the education policy and guides of the government reveal the advocacy to be more for (though not out rightly reject the need for theory) practice oriented education (Bahirdar University, 2007; ASTU, 2011). As a result, many of the modules that form engineering education within the institutions reflect in the curricula both theory and practice with a separate time allocated to each of them.

However, as it is revealed in this study, the implementation of engineering education within the institutions is dominated with more of theoretical than that of the practical aspect. In some respects courses that are practical in their nature are turned to theoretical provision. This implies that there is a problem in attaining the objectives of engineering education and that the changes which are needed to be brought and curriculum implementation are moving in a diverging direction.

7.4. Hopes and Promises Embedded in Reforming Engineering Curriculum

The orientation and perspectives and the basic tenets of curriculum development which are enshrined in the different policy and other related documents of the government (e.g. MoE, 2004; MoE, 2003; MoE 2009), together with the findings of the study in the three sites show, the reform in engineering education was more of economic and social development in their nature in the Ethiopian context, It was economic because, the goal of engineering education as emphasized by many of the government documents (FDRE, Proclamation No. 256/2001; Knoop, n.d) were targeted to the production and development of skilled human resource that would work in the industry. Since the field of engineering is regarded as a crucial part in the economic development of the country, a significant number of young people who are accepted to enroll to higher education are directed to join the various fields of engineering education (MoE, 2008). This obviously implies that more of the resources allocated for higher education are reserved for engineering education with the assumption of producing engineers capable of doing the work the industry needs and who can create a milieu for technology transfer.

The other orientation that guided the reform in higher education is social in its nature, which is expressed in terms of equity. This is expressed in two inseparable ways. The first of these is the concern of creating more opportunity for an extended provision of higher education, which includes engineering education, to a large number of individuals, who were in the past deprived of it (see, for example, ESDP IV: p. 64). This, on the one hand, has attracted many adult members of the society who are involved and working in different public and private sectors. On the other hand, the policy that opened the gate wider for engineering education attracted more young students who could otherwise work better and benefit more if they could join the other fields of science such as management and accounting. As a result, higher education institutions started to create courses and methods of delivery that suits people in such position, usually at the expense of quality in education. The second aspect of equity arises from the need of government to avail educational institutions in close vicinity to the wider populace residing in the wider spatial area of the country. One of the evidences for this is the opening of new universities within a short span of time. However, these institutions operate under poor provision of lack of qualified and experienced teachers, lack of laboratories and workshops to work in and entangled with a number of related problems such as that of the unavailability of resources for students to work with and to learn the necessary knowledge or acquire the skills.

In addition to the economic and social orientations, there is also another element that had a significant role in shaping the reform of higher education in Ethiopia. This arises from the need of meeting the international expectations (Bayou et al 2006: 15) of higher education in general and trying to meet the standards in accordance with it. This has resulted in the introduction of new elements such as modular arrangement of courses, student-centered teaching and learning, continuous assessment, new credit transfer systems (ECTS) and others, on top of the previously known ways of providing higher education, especially in engineering education. Though aligning the higher education system with the international practices is unavoidable, the immature condition, in terms of availing the appropriate human and material resources for its proper application has left teachers and students in a state of confusion. All in all, it implies that the implementation of the reformed curriculum was started with premature conditions which can be expressed in terms of: (1) lack of availing the necessary laboratories, workshops including the equipments and materials within them; (2) shortage of well qualified and well informed teaching staff; (3) lack of follow-up in implementing the change.

7.5. Active Teaching and Learning Methods: Approached to the Goal but Failed to hit the Target

An examination of policy documents as well as the reformed curricular materials of engineering education point out that one of the most important things needed in engineering education is the acquisition and the development of knowledge in engineering sciences and design, together with the related knowledge of other sciences and mathematics including some modules from the humanities field of study. The documents, in addition, highlight the necessity in the acquisition of skills of various kinds such as those of skills in critical thinking, communication, and in doing experiments and laboratory work, and others.

The idea of employing different teaching-learning methods in the teaching learning situation in general is the idea accepted by many educators long ago. Research also shows that students learn better when they are exposed to different teaching and learning methods (Felder & Henriques, 1995; Knowles, 1973). The findings of this study also reveal that teacher and student participants in this study do not deny that there are some attempts of employing different practices in their teaching and learning situation. However, they all express that they are not satisfied with what the teachers are doing as teachers and with what the students are doing as students.

As it has been pointed out in Chapter Two of this study, learning theories, such as that of constructivism and Andragogy, inform us that students learn more and better when they are in a position to participate and construct their own learning. The essence in this assumption is that students learn better when they are provided with the appropriate condition for their learning. Appropriate condition for engineering education obviously, involves among other things, the availability of classroom situations that allow students to communicate with their teachers and peers, availability of books and other reading materials to learn and acquire the knowledge of engineering and other sciences, availability of workshops and laboratories that are sufficient for students to practice in and perform the necessary experiments, experienced, knowledgeable, and motivated teachers who facilitate students' learning with appropriate guide and feedback, machinery, equipment and other accompanying resources to practice and learn the engineering practices. With less or no provision of these resources, it would be difficult to attain the goal of engineering education.

Modern learning theories and Andragogy also inform us that students need varying approaches of teaching and learning rather than sticking to one or two approaches. Lecture methods, demonstrations, discussion methods, assignments, problem based learning, project based learning, laboratory experiments, workshop practices, internships, are some of the among many teaching learning methods that are advocated in the policy document and in the reformed curricular documents of engineering education and which are needed to be employed in the teaching learning of engineering education.

The Ethiopian education policy documents and curricular materials (MoE, 1994; MoE, 2003; MoE; 2009; ESDP IV, 2010;) also advocate that students will be provided with the necessary conditions for their learning. But the findings of this study reveal that neither the conditions of the study are not fulfilled nor the methods of teaching and learning are applied as per the suggestions provided in the documents. The findings further reveal that the dominant method of teaching and learning, apart from labs, is still more of lecture method, with a large number of students in a class and in a difficult situation. Application of demonstration and discussion methods to the required level, are difficult partly due to the large number of students in every session and partly due to the in- sufficiency of equipments and materials. Assignments, as a method of teaching and learning, is threatened with students' improper handling and misusing it and due to lack of proper follow-up from the side of the teachers.

A serious problem in this regard is the teachers' lack of providing feedback to students. Problem based, project based learning, experiments, workshop practices, though practiced in a limited way, in most cases they are hampered partly due to the large number of students and to a larger extent due to the shortage of facilities such as that of laboratory equipments and accompanying resources. Teachers, sometimes, try to practice such methods with the limited available materials and equipments but they fail to provide feedback, for example, for students' assignments and projects.

Internship as a method of teaching and learning in engineering education is one of the embraced method by education policy makers, teachers, industry personnel, and students who participated in this study. Policy documents and curricular materials advocate the importance of internship for students' learning. All curricula documents have incorporated in the engineering education program a one semester internship training for the students. Institutions have also assigned some teachers who have to organize and follow-up the proper functioning of the internship program.

However, implementation of internship training is not without problems of its own. Limited number of industries as compared to the number of students who need internship, leaves students in a situation of wasting too much of their time in searching one, especially in their close vicinity. When they find one in the close vicinity of their institution, it is relatively better because they can meet their supervisor from the university at least once in a while. But if they do not find one in close vicinity it will remain as an internship without follow up and this was the fact experienced by the students who were assigned for their internship training far away from their institutions in the past.

Another problem with internship training is lack of a clear academic guideline with what the students do within the industry. As the finding of this study indicated neither the students nor teachers know what exactly a student would do within the industry training. For instance, a student of Electrical Engineering would go to an industry where electrical engineering is practiced with a broad idea of Electrical Engineering rather than with a specific area within that broad field of study. This has created a difficult situation for both students and for those who are responsible for internship training from the side of the industry. Industry applies activities of Electrical Engineering in different situations. For industry there is no chance to bring all applications of Electrical Engineering in one place and to train all students in the same way. Different applications of Electrical Engineering are practiced in different ways and sometimes in different sites. Hence, as the finding of this study revealed, industry needs students to be clear of their focus and to come to it with specific identified needs for their internship training. If this happens, it will be easier for those who are responsible within the industry to give specific opportunity of training where students can gain the maximum benefit in their focus area.

In general, it implies that internship as a means of teaching and learning is not well exploited due to the reasons which are attributed to: (1) lack of the necessary management and coordination from the side of the institutions; (2) lack of planning and follow-up from the side of teachers; and (3) lack of a clear understanding of the purpose of internship from the side of students.

7.6. Student Assessment as a Ladder to Climb up

As pointed out in the education policy documents and the curricular materials, the purpose of student assessment is to find out the degree to which students have understood the subjects they have learned and to find out where help is required. Assessment, in general refers to collecting data about the quality of student learning (Olds, et al 2005). If a student's assessment result is found to be low, in terms of knowing and understanding of the subject he/she is supposed to know, this implies or suggests that support from the teacher is required in order to improve the students' learning. It also gives a clue to the teacher whether or not to diversify his method of teaching in favor of the improvement of students' learning within the whole class. Assessment can also be used to gauge students' relative stand among the students in a group or in many groups of students. Approaches to assessment can take many types or forms such as assignments, quizzes, mid and final examination, project work and others.

An examination of the available documents and policy guides including engineering curricula documents reveal that the most favored assessment approach is what is known as continuous assessment. This approach suggests that students have to be assessed continuously in different ways rather than judging their ability and understanding of the subject they learn with one or two examination/s. The process of continuous assessment requires teachers to provide feedback to students for every assessment they give to students. Though it is part of the mechanism by which the students passing or failure is determined, its main purpose, as stipulated in the documents, is improving students' learning by way of providing feedback to students or by way of changing the teaching method or methods in such a way that it suits students' learning.

As revealed in the findings of this study, continuous assessment seemed to have failed to do what it is purported to do and in some cases it has become an easy way of students' survival within the institutions. Group and individual assignments as a genuine means of assessment seem to have lost the credibility by many of the students. While few of the students genuinely benefit from assignments in terms of learning the subjects and in terms of scoring higher scores, many others end up copying from those who have worked by themselves and obtain marks. Though teachers are aware of the existence of such a situation among the student body, they admit that they do not have time to check how each student produces his/her assignment work, and they attribute this to the large number of students they are handling and the shortage of time they have.

Quizzes are also regarded as a means of continuous assessment. But as it is revealed in the findings of this study, especially in the case of BiT, quizzes are good for obtaining passing marks because students are told well ahead of time to make themselves ready for the quiz in the particular topic or topics they have covered. They learn the topics or chapters in a fragmented way without giving due concern to its connection to the whole of the main course. But the problem with it, according to the participant students, is its effect in continuously detaching them from the essence of the main course for which they are registered. By the time they learn a specific topic for the purpose of passing each quiz and repeat this several times they tend to lose the connections between the portions covered by the quiz and the broader course for which the topic or the topics are learned. Even though they do not pass in the final examination of that particular course, the cumulative scours of assignments and quizzes would give to the students the opportunity to get a passing mark in the course they have registered for, which means passing the course without the grasping the kernel of the course. This implies the need for better coordination of assignments, projects, and quizzes as a means of assessment.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

8.1. Introduction

The intention in this chapter is to summarize the answers to each of the four research questions posed in Chapter One of the present study in association with the key findings obtained from the analysis. Hence, the chapter, in general, is organized under the four research questions, together with the conclusions drawn from these findings. Finally, a number of recommendations which are thought to be pertinent are forwarded.

8.2. Why was the engineering curriculum reform initiated? How was it developed?

As the findings of this study show, the idea of reform in engineering education was not generated either by the teachers of the engineering institutions or by the leaders of those engineering institutions. It was initiated by ECBP under the leadership of the Ministry of Capacity Building (MoCB). The intention of the university reform component of the ECBP was more of economic interest to support the transformation of higher education to be able to generate the most needed human capital for the work in the labor market of the industry. On the other hand, it was an idea whose target was to support the industry by producing skilled work force that is equipped with knowledge, and ability within the higher education institutions. Although Addis Ababa University was given the opportunity, as it is revealed in the findings of this study, to take the lead and undertake the reform by itself, it did not opt to undertake the reform by itself, but allowed the Faculty of Technology to join the ECBP to perform the reform task together with members in ECBP. The Faculty of Technology was the more preferred engineering institution by the ECBP because of its long experience in providing engineering education and because of the availability of more experienced, knowledgeable and highly qualified teachers within it than in the other engineering institutions existing by then.

Members of the Faculty of Technology at AAiT, under the support of the ECBP and in collaboration with the advice and support of the German professors managed to establish different committees that would deliver on the curriculum development. Each of the committees representing the different engineering fields of studies, after a long time of exercises, meetings, and workshops managed to produce the first generation of curricula in the year 2007 which also served as a spring board for the curriculum development process in the other higher education institutions. These were taken to Germany for a peer review of an accrediting agency known as ACQIN. This process resulted in preaccreditation of the curricula but not the program of engineering education as a whole. However, with this at hand the curricula were implemented in the form of "pilot" implementation in the year 2006/2007 academic year. This then marked the starting point for the implementation of the reformed engineering curricula at least in AAiT.

Engineering curricula for other similar institutions were also produced following the lead of the Faculty of Technology by adopting the curricula which was produced by the Faculty of Technology together with ECBP. In this later case some members of the Faculty of Technology served as advisors to the other institutions, in place of the German advisors. For instance, during the engineering curricula development process of BiT (then Engineering Faculty at Bahirdar University) different staff of AAiT, who are specializing in different fields of study, had served as external advisors.

From these findings, it can be concluded:

The idea of initiating engineering education reform and curricula was an idea that was totally brought by the ECBP. Of course, members of the Faculty of Technology of Addis Ababa University were also active participants in the development of curricula, but under the support of ECBP and under the guidance of the advisors from Germany. The teachers' participation in these activities was not one of independent decision making about the different elements of curricula, but one of learning the decisions of the ECBP and trying to put it in the curricula. The approach in general can be labeled as a top-down approach since the very decisions were determined at the top level. This implies the need for raising and ensuring the awareness of teachers about the ideas of the change in engineering education, understanding of the new decisions together with the newly included curriculum concepts and their purposes.

The target, in reforming engineering education was to produce educated and skilled human resource for the labor market. As the findings of this study reveal, the teaching learning process is affected negatively by teacher absenteeism, shortage of laboratory and workshop equipments, inappropriate assessment mechanism and students' trifling learning styles. This implies that there is a long way to go to improve engineering curriculum development and its implementation within the specific engineering education institutions in Ethiopia. It also implies the need for having teachers who bear responsibility for their teaching, who are highly committed to translate the curriculum and implement it to result in students' learning. In addition, it implies the need for improving and upgrading the teachers' knowledge, understanding, and skills in different methods of teaching and learning that assist students' learning. It also implies the need for adopting new ways of student assessment mechanism than the traditional pencil and paper methods which is still dominant within the institutions.

8.3. How do deans, teachers and students view and describe engineering curriculum and the congruency between the curriculum expectations and its implementation?

As the findings of the study reveal, different teachers see the curriculum in different ways. For some of the teachers engineering curriculum is seen as a plan that leads students to an in-depth learning of engineering sciences and other related subjects. This tends to imply the need for more theoretical knowledge of engineering and the curriculum has to reflect this reality. It also implies that teachers have to give more focus to the theoretical knowledge when they teach students, which is actually in contrary to the ideas of the reformed curriculum. Others associate the objective of engineering education with the developmental agenda of the country; engineering curricula in such case then have to be oriented more to practice than theory. This obviously implies the need for problem solving which is consistent with the reformed curricula. It also suggests that teaching and learning have to look into a problem and try to solve it. Nevertheless, both of these perspectives do not exist separately in the real world. Engineering education without the theoretical backgrounds of the sciences, mathematics and other related sciences cannot exist in this modern era of engineering. In other words engineering education devoid of practical experiences and skills associated with it is no more important than not having it.

As far as the findings of this study show teachers, deans as well as students do believe that implementation of engineering curriculum is seriously jeopardized due to various reasons such as large number of students in each class, laboratory activities and workshop practices and shortage of resources and supporting facilities, shortage of experienced and qualified teachers. They also add other problems such as lack of motivation from the side of teachers and academic background of students. Both teachers and students do not believe that they are doing the right things. Many of the teachers teach to finish what they have to teach; similarly many of the students learn just to pass examination. However, it seems that both teachers and students share the same grief and take the blame to the incapability of the system to improve it. Poor delivery in teaching, poor assessment mechanism, shallow student learning and things like these, in most cases seem to characterize the system, at least in the institutions into which this research was undertaken.

In conclusion one can say that the aim and focus in reforming engineering education is to produce engineers that are endowed with the knowledge, skills, and attitude that would enable the graduating engineers to solve engineering problems and contribute towards the economic and social development of the country. The variation in the perception of the engineering curriculum tends to divert the aim and the focus in the teaching and learning to different direction. As there are teachers who believe and assume that engineering education has to produce engineers who are capable of synchronizing the theoretical knowledge with that of the skill to solve engineering problems, there are also teachers who believe that the main focus in engineering education should be the theoretical aspect rather than it is a practical one. Implementing engineering education based on the first perspective reflects the importance of both theory and practice. On the contrary implementing engineering education based on the second perspective focuses on producing engineers with good background of theory and analysis. So the prevalence of such a varying situation somehow tends to limit the implementation of the reformed curriculum as it was planned. This then implies the need for creating more awareness and continuous training and retraining of teachers with regard to the aims of the reformed engineering education and the changes accompanying it.

8.4. What has influenced the engineering curriculum development process and its implementation?

Curriculum development and its implementation always take place within a society. There is no curriculum development or implementation without society. But society is endowed with a culture of its own which may be a fertile ground for a new idea or an impenetrable rock to the other. Any practice of curriculum development and its implementation has to consider this as much as possible. It is already mentioned that the initiative for engineering education and curriculum reform took place at top level. Teachers' participation in initiating the change aspect was not significant. As far as the findings of this research are concerned, the initiative for reforming engineering education and its curriculum development were influenced by many factors which include the government's needs for a new way of addressing engineering education, to provide higher education, especially engineering education to a large number of young people and the need for the introduction of new ideas in the structure of engineering education. The demanding nature of the growing industry which is expressed in terms of the need for engineers that are knowledgeable, skilled and who can translate their knowledge and skill in the work situation also received top priority among others in the ideas of reforming engineering education and engineering curriculum.

On the other hand, internal factors such as low number and quality of teaching staff which can be expressed in terms of the qualification they have, i.e., Bachelor degree, Masters degree, and PhD, low standards of the teaching learning situation that can be expressed in terms of insufficient and inefficient laboratories and lab equipments, the large number of students in both class and laboratory sessions were among the top factors that have influenced the implementation of the curriculum below the expectations at the institution level. Students' behavior which is expressed in terms of their low ability in mathematics and in the sciences including their preference of choosing easy and shallow ways of study to pass their examination, teachers' behavior that is expressed in terms of their absenteeism from their classes and their reluctance to give timely feed-back on assignments and group works are also among the factors that influenced the implementation of the engineering curriculum at the institution level, especially in the institutions where this study has taken place.

Even though the intentions and the actions taken in reforming engineering education at the top level in terms of decisions, particularly in curricular decisions including the preparation of the framework for the curriculum development were promising at the outset, its implementation in the institutions covered in this study, still lags behind and instigates doubts on the knowledge, skill, and the capability of the engineers trained under this curriculum. This implies that there is a need for looking deep into what is happening within the institutions and make corrections of whatever in order to attain the objectives stipulated in the reformed curricula, which is a matter of more effort and resource.

The reformed engineering curriculum is full of new and imported ideas which are not familiar to the teachers. The inclusion of new ideas in the curriculum is good, but the problem lies with the teachers understanding of it. It is now seven years since the implementation of engineering curricula took place in this country. Yet, as the findings of this research reveal there are teachers who cannot tell what is meant by ECTS, the idea of "holistic examination" and others. This implies that there is a wide gap between the teachers' knowledge of the details of the curriculum and what they are implementing. Moreover, it implies that there is lack of follow-up activities with respect to the proper implementation of the curriculum in general.

In other words, the teaching and learning process is being endangered and probably fails to produce the needed engineers in terms of quality which is expressed in terms of what the graduates know and what they can do, as the result of different factors such as teachers' absenteeism from their teaching duties, application of inappropriate methods of teaching and assessment, insufficient and inadequate set-up of laboratories and workshops, and shortage of teaching and learning materials.

In summary, it can be concluded that teachers in engineering education do not seem to have a full grasp of the ideas of the reformed engineering curriculum and the changes accompanying it. For instance, if you ask two or more teachers about the purpose of a "modularized curriculum" or "ECTS", they don't give you similar answer, yet they all tell you that they are teaching the modularized curriculum. As revealed in the findings of this study, many of the teachers, with the exception of few, stick to the old methods of teaching which is "chalk and talk", paper and pencil assessment mechanism, and less or no provision of feedback to students. This implies that there is distance between the teachers and the ideas of the curriculum.

8.5. How do stakeholders assess their involvement in curriculum design process and its relevance? What are their expectations of the new engineering graduates in terms of their knowledge, skills, and commitments?

There are many stakeholders who directly or indirectly claim that they have stake in engineering. Every development sector, public institutions of different nature, professional societies and many others need the use of engineering. Financing agencies and government organizations always need the good service of engineering as a field and engineers as individuals. Industry obviously is one of the primary stakeholders that demand more than anything appropriate competencies of engineering which is expressed in terms of engineering knowledge and skills for its tasks of manufacturing or services. Engineering teachers and students are also among the primary stakeholders as they are directly involved in the teaching learning process of engineers. Hence, the major focus in this part of the study is on the experiences of engineering teachers, industry, and students.

Engineering teachers feel that decisions about curriculum are not in their hands. What they do as teachers, especially these days, depend on someone’s decision. Changes in curricula are decided without their knowledge, especially in ASTU which is one of the institutions involved in this study. Any suggestion they put forward is not acceptable. As the findings of this study indicate, participation at the initial stage of the engineering curriculum reform was relatively better than the participation in the latter years. As a number of participants indicated participation in curriculum development to most of the teachers is no more than preparing materials for student learning and teaching classes. On the other hand, students as stakeholders, have no say at all with regard to matters related to curriculum development.

The findings of the study also reveal that industry as one of the stakeholders of engineering does not play a major role in curriculum development. So far, it does not seem that the industry has influenced significantly in curriculum development in general. Experiences in other countries show that professional societies in the different areas of engineering exert an immense influence on what happens in engineering and technological education. Engineering education accreditation agencies are also the other part of such influence in other countries (e.g ABET, Washington Accord, and others). Influences such as these ones do not seem to exist in the context of Ethiopia so far. As revealed in the findings of this study, sometimes, some industry representatives are invited to some workshops to suggest and give some feedback on a newly developed curriculum. In most cases, the suggestions and feedbacks they give on such occasional invitations is regarded as participation in curriculum development and this is the most they can do in matters of curricula and curriculum development. However, they are not satisfied with that kind of participation and relationship only. What a participant of this study, from one of the industries, indicated herein below shows how they are concerned with the curricular natter.

> *Now we have the latest technology and we know what it looks like and we use it. They have included the old things. For example, you don’t teach about ICDN these days because the ICDN these days is becoming out. I am telling you an example; there was something like this in that curriculum. This was one of the gaps I have observed in the curriculum* (Ind 1: p. 481).

In summary of this part it can be said that teachers are in the forefront of implementing curriculum. They are the ones that give life to the ideas of the curriculum and who strive for bringing change in the students' body in terms of having knowledge and skills and the capacity what they want to do. But teachers' efforts bear fruit if they themselves have a clear idea of the curriculum and the purposes attached to it. Improving the curriculum development process and its practices without availing the tools to teachers, which is the basic essence, knowledge, and understanding of the change in curriculum does not assure the highest level of curriculum implementation which in the final analysis is expressed in terms of the quality of the students' learning. As far as the findings of this study are concerned, the approach in the process of curriculum development is top-down. Most of the ideas (e.g., modular approach, ECTS, and others) are new to teachers. Even though some efforts were made to introduce and acquaint teachers with the reformed engineering curriculum it seems that there is gap between the intentions expressed in the curriculum and what is practiced at the classroom level as a result of not grasping the essence of the reformed curriculum and partly due to some other related reasons.

In summing up all together, this researcher believes that the analysis of the empirical results has provided insights into the various issues of the engineering curriculum development and consequently to the students' learning. As a result of this qualitative analysis, important conclusions are drawn which have implications for the improvement of engineering curriculum development and for students' learning. Accordingly the following conclusions are made.

The intention in engineering curriculum development and reform was to produce highly knowledgeable and skilled work force that serve the industry and support the development efforts of the country. However, the findings of this study reveal that its implementation effort, so far, do not seem to guarantee the results sought in terms of the quantity and quality of students' learning of the needed knowledge and skill. As revealed in this study engineering curriculum development was a top-down process that involved low participation of teachers in decision making, that is, in determining what must be included in the curriculum and how it should be developed and implemented. The teachers' law participation in curriculum decision making (mainly in ASTU) in terms of what to include in the curriculum and how to develop it at the outset of the curriculum development process, seems to have negatively impacted the subsequent implementation of the curriculum. Improper and low understanding of the newly introduced ideas of the reformed curriculum, that is, the importance and application of continuous assessment, the use and importance of ECTS and some other related ideas left implementation to have a poor stance and have resulted in low commitment of teachers in their practices of teaching and assessment. As a result the traditional ways of assessment and teaching methods still persist and dominate the whole process of the teaching learning within the institutions included in this study.

The perspectives of engineering curriculum as a discipline to be mastered and as transmission of content, which is held by many of the engineering teachers, is one of the barriers to the teaching and learning process of engineering education at present. Improving engineering curriculum development requires changing the perspectives of engineering education as a 'transmission of content' to development of skills that support engineering thinking and professional development. The findings of this study show that teaching and learning, as observed by the participant teachers and students in this study, mainly depended on classroom chalk-and-talk approach. This suggests the need to change such perspectives through continuous professional development of teachers

As the findings of this study also indicate, less motivated teacher behavior, expressed in teacher absenteeism and lack of providing feedback to students, is the other crucial barrier for the proper implementation of the curriculum in engineering education within the institutions. Implementing engineering curriculum and improving students' learning requires the unreserved service of motivated teachers who can accomplish the goal of teaching and learning effectively. Even though the issue of motivation is complex enough, as one of the means to improve their motivation, their remuneration needs have to be considered and addressed to minimize their dissatisfaction in their work of teaching. Teachers in engineering education have little or no training in teaching. This has limited the teacher's capacity of teaching and assessment and gave the option to stick to the traditional approaches in their teaching and assessment activities. In order to create a strong cadre of engineering education and to facilitate innovative abilities and lifelong learning attitudes in students, in the first place, the process of employing teachers of engineering, within the institutions, has to be considerate of additional criteria other than high scores upon their graduation. Such criteria may include the individual's possession of interest in the teaching profession and his or her ability in communication skills. Secondly, during and/or after the employment of the teaching staff, there has to be an established means that supports their continuous professional development and improve their teaching work in all aspects.

8.6. Recommendations

Improving curriculum development and consequently students' learning in engineering education is neither a straightforward explicit process, nor does it involve only a single party such as that of teachers, students, or curriculum developers. As the findings of this research showed, a number of intermingled factors influence curriculum development and students' learning in engineering education. In general, the curriculum development process and students' learning are complex, dynamic and multivariable processes that require a holistic approach to deal with. It is very difficult to single out one "right" model of curriculum that would ensure effective students' learning. The global demands of engineering education, the changing nature of technology, the changing demands of industry, the various curriculum perceptions of teachers and others, the differences in methods of delivery and assessment, individual characteristics of teachers and students, teacher and student motivation, availability of resources and other influences which might in general be categorized as external and internal factors need to be taken into account to facilitate and improve curriculum development and students' learning.

All of these, however, cannot be addressed and get an absolute solution with a single instance of intervention such as the recommendations made in this study. While the findings of the study specifically refer to the institutions into which this research is conducted, the recommendations made can be considered as an option in which policy makers, curriculum developers, IoT leaders, engineering teachers, and others may consider in their pursuit to improve the current status quo of the engineering curriculum development and students' learning. The different factors in the engineering education institutions and the cultural milieu into which the institutions exist may require different approaches to deal with their own particular situations. It would be difficult to assume that these set of recommendations would provide solutions to all contexts or to all persistent problems. Neither the assumption to develop an exhaustive list of strategies nor to attempt to readily provide solutions to all of the complex problems in the Ethiopian engineering education system could be anticipated within the scope of this research. Based on the research objectives, the empirical findings and the theoretical considerations, a number of recommendations are forwarded which may serve as strategic options and framework of actions for improving engineering curriculum development process and students' learning. The conclusions made in this research broadly suggest five major areas that help to bring about improvement in engineering curriculum development and students' learning. These major change areas for improvement are: the need for more involvement of teachers in curriculum development, initial and continuous teacher preparation and the creation of more awareness, creation of links with industry, improvement of the teaching and learning situation, and establishment of a strong assessment policy are needed within the institutions.

The implementation of these recommendations require a systemic approach and collaborative effort of engineering teachers, institution leaders, industry, Ministry of Education and other stakeholders in the education and economic sectors. As engineering curriculum development process is a long term process beginning from the initial learning and continuing throughout the development of the engineers' profession, it is critical to adopt a long term perspective and a systemic approach as opposed to fragmented and temporal changes and reforms in the implementation. The recommendations made under each of the three major areas of change are presented as follows.

8.6.1. The Need for more involvement of teachers in curriculum development

Curriculum improvement is not only a matter of putting new ideas and suggesting new ways of implementing it. The findings in this study show that teachers were called to adopt curriculum ideas that were sought more important than the traditional methods. For the last six, seven years they have been trying to do it as they have been told. Still it appears that most of them have not yet owned it and seem that they do not understand a significant part of it. For this reason they stick more to the traditional methods of doing it. Owning the curriculum from the side of teachers is the most important aspect for proper implementation of the curriculum. As the findings of this research revel, currently there seems to be a wide consensus among teachers on externalizing the problems of curriculum development and its implementation. No matter how well the curriculum document is prepared and no matter what progressive ideas it contains, without the teachers' belief in it and their devotion and commitment to implement it, it is likely that the results would be below what is sought and this seems true in the institutions into which this study is undertaken. This is manifested in two inseparable ways. The first one of these is lack of attention to grasp the essence of the curriculum and what it requires. The other side is to regard teaching simply as fulfilling the obligation that is prescribed by someone outside. Inherent in both of these manifestations is lack of a sense of ownership. This clearly shows that teachers' participation in curriculum development is not to the level it develops their sense of ownership of the curriculum. Hence, it is recommended that teachers have to be part of the decision making process and have a look into the alternatives to be able to choose the most important aspects of engineering education from the outset, rather than being told to fit into a prescribed curriculum.

8.6.2. Provision for initial and continuous teacher preparation and more awareness creation of curriculum change

One of the major areas where change is necessary for improving engineering curriculum development and the practices of teaching and learning is the creation of more awareness and more understanding of the new directions and requirements of engineering education and curriculum. Another area that needs improvement in connection with teachers is their professional development as beginners and as seasoned teachers. Changes in society and technology require continuous adjustment which implies continuous learning to get along with the changes and this is particularly important in engineering education since it is directly connected with the fast changing rate of technology in this era. To cope up with these changes it needs a cultural change of teaching and learning. Without having the background knowledge and skill of teaching and learning it would be difficult for teachers to identify the proper way of implementing the curriculum. To this end, engineering institutions should aim to develop an initial engineering teacher training and continuous teacher professional development mechanism for engineering teachers that can provide the knowledge and skill of teaching and learning, to progressively update and upgrade the teachers' knowledge and skill of teaching and learning, including the mechanisms of assessment.

The approach, by which teachers were taught, is one of the crucial determinants of how they are approaching teaching and learning including assessment of students' learning. With the exception of some attempts of providing limited training in a generic form, knowledge and skill in teaching and assessment of students' learning was not a requirement in engineering teaching in the past. Teachers taught students with their initial background of technical knowledge and skills of engineering sciences and mathematics without having any formal orientation, knowledge and skill of teaching. Though many of such teachers were capable of learning how to teach and assess students through their career of teaching, by themselves, it cannot be said that all engineering teachers are moving towards more of the application of active teaching and learning methods, which are the demands of teaching learning in the modern era, in general. Putting all teachers in this direction, however, may not be possible overnight. But one of the crucial means to bring change in this direction could be with a special institutional effort dedicated to engineering education. It requires a concerted effort of shared leadership and empowering engineering teachers to take the lead in setting the teacher professional development goals and implementation and by creating forums for individual engineering teachers and professional development teams that provide opportunities for learning from each other through discussion, reflection, and critical discourse.

8.6.3. Creating strong link between engineering education institutions and industry

Engineering education creates individuals who ultimately be connected to work in industry. Engineering graduates are the ones who have to strive for the technical functioning, minimizing cost, and the continuous adaptations of new technologies in industry. Industry needs the engineers if they are capable of doing the work it needs. The proper functioning of the industry benefits both industry and engineering graduates. However, for producing engineers who are capable of doing the work in industry, the effort of the education institutions alone is not enough. Industry is always closer to the findings and development of new technology and to implementing it in a rate faster than the educational institutions would think of introducing it in their education system. In this sense, educational institutions lag behind. So, for the proper functioning of the educational institutions, information from industry is crucial. On top of this, research findings which have to be conducted within the institutions, direct information related to the needs of industry would keep the educational institutions abreast. So far, as the findings of this study indicate, the relationship between industry and the educational institutions is very limited and occasional; lacking formality. It appears that the purpose of creating the needed engineers is left out to the educational institutions without any significant input from the industry. Hence, it would be crucial to form a strong link between industry and the educational institutions beyond the occasional meetings and the internship relationships. To this end, engineering institutions should aim at:

- Establishing legally supported permanent forum between the educational institutions and industry whose aim is liaison between both the needs of industry and the contents of courses in the educational institutions;
- Cooperation with industry and using the potentials of industry for the education and training purposes.

8.6.4. Improving teaching learning situation using various options

Though undergraduate engineering students, in most cases, have to concentrate on learning the fundamental knowledge and the thinking skills of engineering sciences and other subjects related to it, they also need to know how to apply this in the practical situation of work and be able to solve prevailing and new problems. Their ability to do this by large depends on how well they learn and test the methods of synchronizing the theory with practice within laboratory or other similar situations. This in turn requires the availability of a situation conducive to teaching and learning which is expressed in terms of availability of working and testing equipment and materials, availability of sufficient space for individual students to practice with and availability of well qualified teaching staff that can guide the practices. To this end, institutions have to make the utmost effort in establishing and fulfilling the basic requirements of laboratories and workshops for each of the particular fields of studies in any way possible. This may include:

Alternative One: - establishing and equipping laboratories within each of the technology institutions and availing to students learning within it. This may be the most preferable way as it gives better opportunity for students to learn within a close vicinity of their campuses without involving longer trips to other places.

Alternative Two: - forming a cluster of institutions that avail the existing laboratories, workshops, and the equipments within them to share and use cooperatively in a planned way. This may obviously involve additional effort and cost in transporting students from their campuses to the institution where the laboratories and workshops exist. But in terms of engineering education, it is much better than leaving students without having the practical component of a course or courses.

Alternative Three: - Arranging a special arrangement with industries that possess laboratory, workshop arrangements, and equipments that are different from what the institutions have and use these for students' learning. This, on top of its additional advantage of giving opportunity to the students in terms of knowing the reality of work situation, it serve as a means to fill the gap between what the institution has and what the learning of the specific courses require. But it may incur, probably more effort and cost, like the case in Alternative Two mentioned above, but it is still much better than graduating students without having touched those equipments and without having some practice on them as per the requirements of the course.

8.6.5. Improving the assessment process

The process of assessment in engineering education deals with finding out the efficiency of the teaching learning process in creating students who have knowledge of engineering and related sciences and capable of translating these into a real work situation. Even though the act of conducting assessment takes place in a group situation, the results of assessment should speak of the individual students. Assessment results have to provide information about each individual's possession and understanding of the knowledge and his/her ability of translating this knowledge into practical situation. Assessment, in any formal education, requires individual task or tasks performed in groups, under tight control of the teacher, and has to provide evidence of each student's learning of the subject and his/her ability of translating the knowledge into work situation. The current assessment practice, in many ways, seemed to fail to measure the actual performance of each student and, thus, needs a closer attention from the side of the institutions. To this end, institutions have to create a mechanism that:

- requires students to involve in deep learning, understanding of the subject matter and ability of translating the subject matter into a real work situation rather than shallow learning which is targeted simply to pass examination.
- differentiates those assignments, quizzes and practice projects that are performed for learning purposes and those used for making decision about individual students' learning.
- ensures the reliability of the assessment values provided to each of the students to reflect the actual or the true performance of each student.
- ensures the authenticity of each individual's piece of work that counts for the purpose of determining the students' relative stance among the whole group of students.

8.6.6. Research in the future

As yet, very limited or no research has been conducted with regard to engineering education in a comprehensive form within the context of Ethiopia. This implies that there is a long way to go in the future along this side. Engineering education at present has become the top priority in higher education. Hence, it requires not only qualified teachers, but also more gratified of researchers who would pinpoint the strengths and pitfalls that may facilitate or jeopardize students' learning. Findings of educational research should play the role of alerting institutions in terms of the current situation and the demands of engineering education and how to deal with it in a teaching and learning situation. Since the ultimate goal of providing engineering education is to make sure the production of appropriate and skillful human resource who strive for the development of innovation and for suggesting better ways of improving the engineering process, research findings along this line could be helpful for leaders of the institutions, teachers and students. In view of this, engineering education institutions and teachers are recommended to aim for conducting research on the following and other related topics.

- The Extent to which active learning methods are applied in engineering education and its effects on student learning.
- Teachers' perception and understanding of modular curriculum in engineering education.
- The application of continuous assessment in engineering education; its advantages and disadvantages for students' learning.
- The teaching learning and assessment process of selected engineering courses (modules) and its implication to students' learning.

Bibliography

› T [›eÑÊU (2002 ¯.U) "¾Ÿõ }— ƒUI`ƒ Y`¯} ƒUI`ƒ ›Óvw'ƒ" **የመማሪያ ግብዓቶች ይዞታ**" in Quality of Higher Education in Ethiopian Public Institutions, (pp. 57 – 93) Addis Ababa: Forum for Social Studies.

A World Bank Sector Study (2003), Higher Education Development for Ethiopia: Pursuing the Vision, Document of the World Bank, January 20, 2003.

Aamodt, A. M. (1982) Problems in Doing Nursing Research: Developing a Criterion for Evaluating Qualitative Research, *West J Nurs Res FALL 1983 vol. 5 no. 4 398-402*

AAU, (2008), Student Handbook, Addis Ababa: Office of the Registrar.

AAU, (2011), Library Link, AAU Libraries Newsletter, Volume III Issue II, January 2011

AAU, (2012), Reorganization of Structural Set-up and Governance System of the University, Part I, March 2012.

ABET (2010), Board Rules and Regulations Relating to the Practices of Professional Engineering and Land Surveying, California Code of Regulations, Title 16, Division 5 §§ 400-476, Article 1. General Provisions.

ABET (2010), Criteria for Accrediting Engineering Programs: Effective for Evaluations during the 2011-2012 Accreditation Cycle.

ACQUIN (2007), Evaluation Report, unpublished paper.

Council of Ministers, (2006). Adama University Establishing Council of Ministers, Regulation No. 120/2006, Addis Ababa, 23rd January 2006.

Adams, M. et al., (2011). Multiple Perspectives on Engaging Future Engineers, Journal of Engineering Education, January 2011, Vol. 100. No. 1, pp. 48-88.

Adelman, C. (2009). The Bologna Process for U.S. Eyes: Re-learning Higher Education in the Age of Convergence.

Akker, Jan van den, Wilmud K., and Uwe, H., eds.,(2003), Curriculum Landscapes and Trends. Dordrecht: Kluwer Academic Publishers.

Alemayehu B. and Lasser, J. (2012). Education in Ethiopia: Past, Present and Future Prospects, African Nebula, Issue 5, 2012, pp. 53-69, *http://nobleworld.biz/images/5-Lasser_s_paper.pdf*

Altrichter, H. and Eillott, J. (eds.) (2000), Images of Educational Change, Buckingham • Philadelphia: Open University Press.

Amare A. (2005). Higher Education in Pre-Revolution Ethiopia: Relevance and Academic Freedom, The Ethiopian Journal of Higher Education Vol. 2 No. 2 December 2005.

Amare, A, (2004), Debates in Research Paradigms: Reflections in Qualitative Research in Higher education, The Ethiopian Journal of Higher education, Vol. 1. No. 1 June 2004 (pp. 41 – 61).

Amare, A. (1998), “Culture and Development” sited and quoted in Woube K., (2000) “The Need for Analyzing Culture in Planning Curriculum” IER FLAMBEAU, Volume 11, Number 2, June 2004.

Amare, A. (2000), A Welcome speech delivered to an audience of a conference at AAU conference Hall. August 11–12, 2000.

Ambrose, S. A. (2013), Undergraduate Engineering Curriculum: The Ultimate Design Challenge, The Bridge, Vol. 43, No. 2, Summer 2013, National Academy of Engineering

American Society for Engineering Education (2010), The Green Report – Engineering Education for a Changing World, Washington D.C., web: www.asee.org

Asres, B. (n.d.), Addis Ababa University: General Information, Addis Ababa University, Office of External Relations, Partnership and Cooperation.

ASTU, (2007). Study Program for the Degree of Bachelor of Science (B.Sc.) in Civil Engineering. Department of Civil Engineering, ASTU

ASTU, (2011), Five-Year Strategic Plan (2011/12-2015/16) September 2011.

ASTU, (2011). Undergraduate Curriculum. Department of Mechanical and Vehicle Engineering, ASTU.

ASTU, (2012), Senate Legislation, Adama Science and Technology University, January 25, 2012

AU, (2007a), Study Program for the Degree of Bachelor of Science (B.Sc.) in Civil Engineering, Faculty of Engineering, Department of Civil Engineering.

AU, (2007b), Study Program for the Degree of Bachelor of Science (B.Sc.) in Mechanical Engineering, Faculty of Engineering, Department of Mechanical Engineering.

Ayalew, S. (1982), An excerpt from "Planning Issues Identifiable by Qualitative Analysis of the Ethiopian Education System (unpublished Master's Thesis), University of Bristol.

Ayalew, S. Dawit M., Tesfaye S. and Yalew E. (2009), Assessment of Science Education Quality Indicators in Addis Ababa, Bahir Dar and Hawassa Universities, Addis Ababa: Forum for Social Studies.

Ball, S. J. (1999). Global Trends in Educational Reform and the Struggle for the soul of the Teacher, Paper Presented at the British Educational Research Association Annual Conference, University of Sussex at Brighton, Sept., 2-5.

Barnett, R. & Coate, K. (2005), Engaging the Curriculum in Higher Education, UK: Open University.

Barnett, R. (edit.) (2005), Reshaping the University: New Relationships between Research, Scholarship and Teaching, Society for Research into Higher Education & Open University Press.

Baxter, P. & Jack. S. (2008), Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers, *The Qualitative Report* Volume 13 Number 4 December 2008 544-559 http://www.nova.edu/ssss/QR/QR13-4/baxter.pdf

Bayou, Tenagne, Buhler, and Oswald (2006), AAU: Faculty of Technology Curriculum Reform, Book I, Introduction, Addis Ababa, 2006.

BDU, (2007), Study Program for the Degree of Bachelor of Science (B.Sc.) in Electrical Engineering. Faculty of Engineering, Department of Electrical Engineering.

BDU, (2007), Study Program for the Degree of Bachelor of Science (B.Sc.) in Mechanical Engineering. Faculty of Engineering, Department of Mechanical Engineering.

BDU, (2007), Study Program for the Degree of Bachelor of Science, (B.Sc.) in Civil Engineering. Faculty of Engineering, Department of Civil Engineering.

Beauchamp, G. A. (1982) Curriculum Theory: Meaning, Development and Use. Theory into Practice, Vol. 21, No. 1, Curriculum Theory, (winter, 1982), pp. 23-27, Taylor & Francis, Ltd.

Beyer, L. E & Apple, M. W. (edits) (1998), The Curriculum: Problems, Politics, and Possibilities, U.S: State University of New York.

Biggs, J. (2003), Aligning Teaching and Assessment to Curriculum Objectives, Learning and Teaching Support Center.

Biggs, J., & Tang, C. (2007), Teaching for Quality Learning at University (3rd ed.), Society for Research into Higher Education & Open University Press, McGraw Hill.

Blackmore, P & Kandiko, C. (2012), Strategic Curriculum Change: Trends in Universities, USA and Canada: Routledge.

Bleiklie, I. (2004), Diversification of Higher Education Systems: in Papers produced for the UNESCO Forum Regional Scientific Committee For Europe and North America, Paris, March 2004 (pp 17 – 39).

Bloom, D. Canning. D. and Chan, K. (2006), Higher Education and Economic Development in Africa, Human Development Sector, Africa Region

Bloom, D., Canning, D. & Chan, K. (2005), Higher Education and Economic Development in Africa, Harvard University

Bordogna, J., Fromm, E. and Ernst, E. W. (1995), An Integrative and Holistic Education, Journal of Science Education and Technology, Vol. 4, No. 3, 1995

Borrego, M. et.al, (2009), Quantitative, Qualitative, and Mixed Research Methods in Engineering Education. Journal of Engineering Education 98 no1, January 2009, pp 53-66.

Boyce, C. & Neale, P. (2006), Conducting In-depth Interviews: A Guide for Designing and Conducting In-Depth Interviews for Evaluation Input, Pathfinder International Tool Series Monitoring and Evaluation–2

Braslavsky, C. (2000), The Secondary Education in Curriculum in Latin America: New Tendencies and Changes, Brennan, J. King, R. and Lebeau, Y. (2004), The Role of Universities in the Transformation of Societies: An International Research Project Synthesis Report, London: Association of Commonwealth Universities.

Brent, R & Felder, R. M. (2003), A Model for Engineering Faculty Development, Intl. Journal of Engr. Education, 19*(2), 234–240 (2003).*

Brinkmann S. & Kvale, S (2005), Confronting the Ethics of Qualitative Research, *journal of constructivist psychology*, 18:157–181, 2005, Taylor & Francis Inc.

Brown, G. with Bull, J. and Pendlebury, M. (1977), Assessing Student Learning in Higher Education, New York: Routledge.

Campbell, D.A. et al. (2007), Balancing Pedagogy and Student Experience in First-Year Engineering Courses In Proceedings of the 3rd International CDIO Conference, MIT, Cambridge, Massachusetts, USA, June 11-14, 2007

Campbell, J. R. (2012), Building an IT Economy: South Korean Science and Technology Policy, Issues in Technology Innovation, Number 19, Executive Summary, Troy University, September 2012.

Carew, A. L., Wickson, F. & Radcliffe, D. (2006), Lessons from transdisciplinarity studies in the design and evaluation of engineering education research. AAEE - Annual Conference of Australasian Association for Engineering Education (pp. 1-7). Auckland, NZ: Australasian Association for Engineering Education.

Case, J. M. and & Light, G., 2011). Emerging Methodologies in Engineering Education Research, Journal of Engineering Education, January 2011, Vol. 100, No. 1, pp. 186–210 http://www.jee.org

Cheng, Y. C. (2005), New Paradigm for Re engineering Education: Globalization, Localization and Individualization, Series: Education in the Asia-Pacific Region: Issues, Concerns and Prospects, Vol. 6

Chism, N. V. N. et al. (2008), Qualitative Research Basics: A Guide for Engineering Educators, Rigorous Research in Engineering Education, NSF DUE-0341127, 2008.

Clark, B. & Neave, G. (1992), The Encyclopedia of Higher Education, Vol. 3, Oxford, New York, Sequl, and Tokyo: Pergamon Press.

Clark, John A. (1995), Ethical and Political Issues in Qualitative Research from a Philosophical Point of View. Paper presented at the annual Meeting of the American Educational Research Association (San Francisco, CA, April 18 – 22, 1995)

Cloete N, Bailey T, Pillay P, Bunting I & Maassen P, (2011), Universities and Economic Development in Africa. CapeTown: Centre for Higher Education Transformation.

Cloete, N. Bailey, T. and Maassen, P. (2011), Universities and Economic Development in Africa Pact, academic core and coordination Executive Summary of Synthesis Report. Wynberg: COMPRESS.dsl | www.compressdsl.com .

Cohen, Solomon, (2008), Long Range Perspectives for the Education Sector: Ethiopia Roadmap Report, Report Prepared for the Ministry of Education, Ethiopia, and the UNDP, DAG Secretariat, 1st September 2008.

COPERNICUS-CAMPUS, *COPERNICUS-Guidelines for Sustainable Development in the European Higher Education Area:* How to incorporate the principles of sustainable development into the Bologna Process, www.copernicus-campus.org.

Cordier, H. (2007), The Future of Higher Education in the Field of Technology in Ethiopia- with Special Focus on Governance Issues. ECBP, with contributions by the Task Force "Governance" of the Faculty of Technology at Addis Ababa University, A Draft document.

Cornbleth, C. (1988), Curriculum In and Out of Context, Journal of Curriculum and Supervision, winter 1988, Vol. 3, No. 2, 85-96.

Coyle, E. (2009), Engineering Education in the US and the EU. Chapter 5 in Engineering in Context. Academia, 2009.

Crauss, S. E. (2005), Research Paradigms and Meaning Making: A Primer, The Qualitative Report Volume 10 Number 4 December 2005 758-770

Crawley, E., Malmqvist, J., Ostlund, S., and Brodeur, D (2007), Rethinking Engineering Education: The CDIO Approach, New York: Springer Science Business Media, LLC

Creswell, J. W. (2003), Research Design Qualitative, Quantitative, and mixed methods Approaches (second edition), Thousand Oaks. London. India: SAGE Publications.

Creswell, J. W. (2007), Qualitative Inquiry Research Design" Choosing Among Five Approaches (2nd ed.) Thousand Oaks, London, New Delhi: SAGE Publications.

Davis, D.C. & Davis, I.T. (2005), Definitions, Comparisons, and Research Bases *Journal of Engineering Education* April 2006. Delhi: SAGE Publications.

Davis, M. H (2003), Outcome-based education, JVME 30(3) ©2003 AAVMC. http://www.utpjournals.com/jvme/tocs/303/258.pdf

Demis, A., Alem, B. Daniel, K. and Edessa, D. (2006), AAU Faculty of Technology Curriculum Reform, Book III, Department of Mechanical Engineering Addis Ababa, 2006, Printed at CCC, Münster, Germany..

Denzin, N.K., & Lincoln, Y.S., (1994), Introduction: Entering the Field of Qualitative Research, in Denzin, N.K., & Lincoln, Y.S. (eds.) Handbook of Qualitative Research. Thousand Oaks, CA: Sage.

Derebssa D. (2006), Issues in the Implementation of Ethiopian School Curriculum, Medawalabu University.

Dolence, M. G., (2003), The Learner – Centered Curriculum Model: A Structural Framework for Technology Planning. EDUCAUSE Centre for Applied Research, Research Bulletin Volume 2003, Issue 17, August 2003.

Doll, R. (1989), Curriculum Improvement: Decision Making & Process (4th ed.), Boston: Allyn & Bacon.

Donnelly, K. (2007), Australia's adoption of outcomes based education: A Critique, Issues in Educational Research, 17(2), 2007

Dorsch, N. G. & Jackman, D. H. (The Politics Of Standards-Based Curriculum In A Course-Based Environment Journal of College Teaching & Learning, Volume 1, Number 4, (pp. 43 – 50), Northern Illinois University.

Drebssa, D. S. (2006), Tension Between Traditional and Modern Teaching-Learning Approaches in Ethiopian Primary Schools, CICE Hiroshima University, Journal of International Cooperation in Education, Vol. 9, No 1, (2006) pp.123-140

Ducote, J. M. (1985)' Curriculum in Higher Education: Historical Influences and Curricular Models. Paper presented at a Meeting of the Mid-South Educational Research Association (Biloxi, MS, November 6-8, 1985).

Duderstadt, J. J. (2008). Engineering for a Changing World: A Roadmap to the Future of Engineering Practice, Research, and Education. The Millennium Project, The University of Michigan.

Dym, C.L., Gogino, A. M. A, Eris, O. Frey D. D., and Leifer, L. J. (2005), "Engineering Design Thinking, Teaching, and Learning", Journal of Engineering Education, January 2005, (pp. 103 – 120)

Dyrenfurth, M. Murphy, M. & Grimson, W. (2009), Implications of Philosophy for Engineering and Engineering Technology Bachelors Programs, Proceedings of INTED2009 Conference 9-11 March 2009, Valencia, Spain.

ECBP, (2009), Framework and Change Management Concept for Setting up Institutes of Technology in Ethiopia. Addis Ababa, 26th June 2009.

ECBP, (2010), Five Years Strategic Plan (2003 – 2007), Zero Draft. April 2010. Education, Audiovisual and Culture Executive Agency, (2009).Higher Education in Europe 2009: Developments in the Bologna Process, ISBN 978-92-9201-023-2

El Maraghy, (2011), Future Trends in Engineering Education and Research: In G. Seliger et al. (eds.), Advances in Sustainable Manufacturing: Proceedings of the 8th Global Conference on Sustainable Manufacturing, DOI 10.1007/978-3-642-20183-7_2, © Springer-Verlag Berlin Heidelberg 2011

Ellis, A. K. (2004), Exemplars of Curriculum Theory, New York: Rotledge.

Elwell, F. (1999), Industrializing America: Understanding Contemporary Society through Classical Sociological Analysis, West Port: Praeager Publishers.

El-Zein, Abbas et.al. (2008), Sustainability and ethics as decision-making paradigms in engineering curricula, International Journal of Sustainability in Higher Education, Vol. 9 No. 2, 2008 (pp. 170 – 181) University of Sydney, Sydney, Australia).

Ensor, P. (2004), Contesting Discourses in Higher Education Curriculum Restructuring in South Africa, *Higher Education*, 48, pp. 339-359.

Ernst, E. W. (1998), Review of Reports, Studies, and Conferences, In: Ernst, E. W. & Peden, I. C. (Conference co-chairs), Realizing the New Paradigm for Engineering Education, proceedings, June 3-6, 1998

Ethio-German Government Negotiations in Berlin, from (2005), Summary Record of the Ethio-German Government Negotiation in Berlin from 17 to 18 March 2005.

Ethiopian Economic Association EEA (2008), The current State of the Construction Industry, Report on the Ethiopian Economy, Volume VI, 2006/07, Addis Ababa.

Ethiopian Science and Technology Agency, (2006), Background Document for Revision of the National S&T Policy of Ethiopia, June 2006.

European Association for Quality Assurance, (2005), Standards and Guidelines for Quality Assurance in the European Higher Education Area, Helsinki, http://www.enqa.net/bologna.lasso.

FDRE, (1994), Education and Training Policy, Addis Ababa, April 1994.

FDRE, (2004), Report on the Development of Education in Ethiopia to the UNESCO Forty-Seventh Session of the International Conference on Education, 8 – 11 September 2004, Geneva, Switzerland.

Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia (2001), Proclamation No. 256/2001

Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia, (2003), proclamation No. 351/2003, 9th Year No. 72, Addis Ababa, 3rd July 2003.

Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia, (2009), Proclamation No. 650/2009, Higher Education Proclamation, 15th Year No. 64, Addis Ababa 17th September, 2009.

Felder R. M., Brent, R. & Prince, M. J. (2011), Engineering Instructional Development: Programs, Best Practices, and Recommendations, *Journal of Engineering Education*, *100*(1), 89 –122 (2011).

Felder, R. & Prince, M. (2007), The Case for Inductive Teaching: PRISM, Vol. 17(2), p. 55, October 2007

Felder, R. M. (2012), Engineering Education: A Tale of Two Paradigms, In: McCabe, B., Pantazidou, M., & Phillips, D., eds. (2012), Shaking the Foundations of Geo-Engineering Education, pp. 9–14, Leiden: CRC Press.

Felder, R. M. & Brent, R (2004), The Intellectual Development of Science in Engineering Students: Teaching to Promote Growth, *Journal of Engineering Education*, *93* (4), 279–291 (2004).

Felder, R. M. & Brent, R. (2003), Designing and Teaching Courses to Satisfy the ABET Engineering Criteria *Journal of Engineering Education*, *92* (1), 7-25 (2003).

Felder, R. M. & Brent, R. (2004), The ABC'S of Engineering Education: ABET, Bloom's Taxonomy, Cooperative Learning, and so on, Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition, American Society for Engineering Education 2004.

Felder, R. M. & Brent, R. (2004), The Intellectual Development of Science and Engineering Students: Part 1. Models and Challenges, *Journal of Engineering Education, 93* (4), 269–277 (2004).

Felder, R. M. & Brent, R. (2009) Active Learning: AN Introduction, *ASQ Higher Education Brief, 2*(4), August 2009

Felder, R. M. & Silverman, L. K (1988), Learning and Teaching Styles in Engineering Education, Engr. *Education, 78*(7), 674–681 (1988)

Felder, R. M. (1997), On Creating Creative Engineers, *Engineering Education, 77*(4), 222–227 (1997).

Felder, R. M. (2007), Research on Teaching and Learning in Engineering* (* Academy of Chemical Engineers Award Lecture, Department of Chemical and Biological Engineering, University of Missouri-Rolla, April 18, 2007.)

Felder, R. M. and Henriques E. R. (1995), Learning and Teaching Styles In Foreign and Second Language Education, Foreign Language Annals, 28, No. 1,1995, pp. 21–31

Felder, R. M. et al. (2000), The Future of Engineering Education II: Teaching Methods That Work, *Chem. Engr. Education, 34*(1), 26–39 (2000).

Flinders, D. J. & Thornton, S. J. (2004), The Curriculum Reader (2nd ed.), New York and London.

Fosnot, C. T. (2005), Constructivism Revisited: Implications and Reflections, The Constructivist, Fall, 2005, Vol. 16, No.1http://www.uen.org/utahstandardsacademy/math/downloads/level-1/3-1-ConstructivismRevisited.pdf

Fosnot, C.T. (edit.) (2005), Constructivism, Theory, Perspectives and Practice, (2nd ed.), New York and London: Teachers College, Columbia University.

Fraser, S. P & Bosanquet, A.M. (2006).The Curriculum? That's Just a Unit Outline, Isn't It? Studies in Higher Education, 31:03, 269-284.

http://dx.doi.org/10.1080/03075070600680521 (Accessed on 09 January 2014) Rutledge.

Fromm, E. (2003). The Changing Engineering Educational Paradigm, Journal of Engineering, April, 2003 (pp. 113 – 121).

Fry, H., Ketteridge, S. & Marshall, S (2009) (eds.), Understanding Student Learning: in Handbook for Teaching and Learning in Higher Education: Enhancing Academic Practice (3rd ed.), New York & London: Routledge, pp 8-26.

Fullan, M. (1989), Planning, Doing, and Coping with Change: in Moon, B., Murphy, P., and Raynor, J. (eds.), Policies for the Curriculum (pp. 183-211), London. Sydney. Auckland. Toronto: Hodder & Stoughton.

Fullan, M. (2006), Change theory: A force for school improvement, Victoria: Centre for Strategic Education, 2006.

Fullan, M. G. (1994), Coordinating Top-Down and Bottom-Up Strategies for Educational Reform, Systemic Reform, Perspectives on Personalizing Education-September 1994

Gale, et al, (2013), Using the framework method for the analysis of qualitative data in multi-disciplinary health research, BMC Medical Research Methodology 2013, 13:117 http://www.biomedcentral.com/1471-2288/13/117

Gao, S. Neilson, J. C. & Goscinski1, A. (2013), Constructivist Learning: Understanding and Experience in IT Tertiary Education, Journal of Curriculum and Teaching, Vol. 2 No. 2, 2013.

Giroux, H. A. (2015), Democracy in Crisis, the Specter of Authoritarianism, and the Future of Higher Education, Journal of Critical Scholarship in Higher Education and Standard Affairs: Vol. 1, Article 7. Pp. 101-113.

Glasersfeld (1998), Why Constructivism must be Radical, In: M. Larochelle, N. Bednarz & J. Garrison (eds.) Constructivism in Action, Cambridge, UK: Cabridge University Press, 1998, pp. 23-28.

Glasersfeld (2005), Introduction: Aspects of Constructivism, In: Fosnot, C. T. (2005), Constructivism: Theory, Perspectives, and Practice, Second Edition, Chapter 1.

Glasersfeld, E. V. (1989), Constructivism in Education, In: T. Husen & T. N. Postlethwaite, (eds.) (1989) The International Encyclopedia of Education, Supplement Vol. 1, Oxford/New York: Pergamon Press, 162-163.

Glatthorn, A. A. & Jailall, J. M. (2009), The Principal as a Curriculum Leader: Shaping what is taught and tested (3rd ed.), Thousand Oaks: Corwin Press, a SAGE company.

Gordon, B. M. (1984), "What is an Engineer?" Invited Keynote Presentation, Annual Conference of the European Society for Engineering Education (SEFI), University of Erlangen-Nürnberg: in (Crawley, et al. 2007: 11).

Gosper, M. and Ifenthaler, D. (eds.) (2014), Curriculum Models for the 21st Century: using Learning Technologies in Higher Education, New York: Springer. http://books.google.com.et/books?

Governance and Organizational Reform Taskforce Faculty of Technology, Addis Ababa University (2007), Draft Proposal for Governance and Organizational Reform of the Faculty of Technology (AAU) within the Framework of Engineering Capacity Building in Ethiopia. February 2007.

Grasso, D. & Burkins, M. B. (eds.) (2010), Holistic Engineering Education: Beyond Technology, New York: Springer Science+Business Media, LLC 2010

Gu, Peihua, et.al. (2006). The development of design directed engineering curriculum based on the CDIO framework, World Transactions on Engineering and Technology Education, Vol.5, No.2, 2006 (pp.267-270)

Guba, E.G (1981), Criteria for Assessing the Trustworthiness of Naturalistic Inquiries. Educational Communication and Technology Journal, 29, 75-92.

Guba, E.G., & Lincoln, Y.S. (1994), Competing Paradigms: In Qualitative Research. In: N.K. Denzin and Y.S. Lincoln (eds.), Handbook of Qualitative Research, London: SAGE publications. Pp. 105-117

Guri-Rosenblit, S. and Sebkova, H. (2004), Diversification of Higher Education Systems: Patterns, Trends and Impacts, Papers produced for the UNESCO Forum Regional Scientific Committee for Europe and North America, pp. 40-69, Paris, March 2004.

Guskey, Thomas (1992), the Implementation of Focusing on Student Outcomes, NCA Quarterly 66. No. 3 (1992).

Hammersley, M. and Atkinson, P. (1995), *Ethnography: Principles in Practice*, (Second Edition), pp 263-287, London, Rutledge.

Hancock, B., Ockleford, E. & Winderidge, K. (2009), An Introduction to Qualitative Research, The NIHR RDS EM/ YH, 2007

Hancock, Beverly (1998) (updated 2002), Trent Focus for Research and Development in Primary Health Care: An Introduction to qualitative Research, Trent Focus 1998.

Hancock, D. R. & Algozzine, B. (2006), Doing Case Study Research: A Practical guide for Beginning Researchers, New York and London: Teachers College Columbia University.

Hansen, R. E. (1995), "Five Principles for Guiding Curriculum Development Practice: The Case of Technological Teacher Education" Electronic Journal, Journal of Industrial Teacher Education, winter 1995 Volume 32 Number 2, University of Western Ontario.

Harald, J. (2012), Tribes, territories and commons in Teacher Education: Looking backwards in ten years with a mode 2 curriculum projects, The International Handbook of Cultures of Professional Development for Teachers: Strasbourg – France, pp. 393-415.

Hargreave, A. (2000), Four Ages of Professionalism and Professional Learning, Teachers and Teaching: History and Practice, Vol. 6, No. 2, 2000, pp. 151-182

Hargreaves, A. (1994), Critical Introduction, in I. Goodson (ed.), Studying Curriculum (pp. 1-11). Buckingham, UK: Open University Press.

Harlan, C (1974), The Little League and the Imperatives of Interdependence. Paper presented at the Annual Meeting of the National Association of State Universities and Land Grant Colleges (Washington, D.C., November 1974)

HELENA Consortium (2009), State of the Art: Curriculum Research in Engineering, HELENA Deliverable D2.3. Place of Publication is not mentioned.

Hensen, R. E. (2001), Curriculum Planning, (2nd ed.) Boston: McGraw Hill

Henson, K. T. (1995), Curriculum Development for Education Reform, New York: Longman. http://scholar.lib.vt.edu/ejournals/JITE/v32n2/hansen.html

HESO report: Higher Education Strategy Overhaul Committee of Inquiry into Governance, Leadership and Management in Ethiopia's Higher Education System *(HESO)*.

Hewitt, Thomas W. (2006). Understanding and Shaping Curriculum: What we teach and Why, Thousand Oaks: Sage Publications, Inc

Heywood, J. (2005), Engineering Education Research and Development in Curriculum and Instruction, New Jersey and Canada: IEEE Press, A John Wiley & Sons, Inc., Publication.

Hicks, O. (2007), Curriculum in higher education in Australia, Higher Education Research and Development Society of Australasia Inc. Proceedings of the 30th HERDSA Annual Conference, 8-11 July.

Hlebowttsh, P.S. (2005), Generational Ideas in Curriculum: A Historical Triangulation, Curriculum Inquiry, Ontario Institute for Studies in Education of the University of Toronto (pp. 73 – 87).

Hooper, R. (1971), The Curriculum: Context, Design, and Development, Oliver & Boyed, Edinburgh in Association with the Open University Press.

Hoyle, E. (1971), How Does the Curriculum Change; in Hooper (ed.) (1971) The Curriculum: Context, Design & Development, pp. 375 – 398. Oliver & Boyd, Edinburgh in association with the Open University.

Huber, J. and Harkavy, I. (2007) (edits.), Higher Education & Democratic Culture, Paris: Council of Europe.

Illeris, K. (edit.)(2009), Contemporary Theories of Learning: Learning Theories…in their own words, London and New York: Rutledge.

ISESCO and UNESCO. (1999), Improving the Effectiveness of Curriculum Development and Reform in Africa, A handbook for curriculum planners.

Jackson, P. W. (1980), Curriculum and its discontents, Curriculum Inquiry, Vol. 10, No. 2 (summer, 1980), pp. 159-172.

Jacob, E. (1988), Clarifying Qualitative Research: A focus on Traditions, Educational Researcher, 1998, Vol. 17, No. 1, 16-24.

Jansen, J. & Christie, P. (eds.) (1999), Changing Curriculum: Studies on Outcomes-based Education, South Africa: Jut Co. Ltd.

Jenkins, A, et al. (2003), Reshaping Teaching in Higher Education: Linking Research with Teaching, London and New York: Rutledge.

Jenkins, D. (1976), Curriculum Evaluation, Milton Keynes: the Open University Press

Jessup G. (1991), Outcomes: NVQs and the Emerging Model of Education and Training, New York: RoutledgeFalmer.

Johnson, D. W., & John, R. T (1994), Learning together and alone: Cooperative and individualistic learning (4^{th} ed.), Boston, MA: Allyn and Bacon.

Johnson, J. A., (2001), Principles of Effective Change: Curriculum Revision that Works, The Journal of Research for Educational Leaders, Volume 1, Number 1, Fall 2001, http://www.uiowa.edu

Karseth, B. (2006), **"**Curriculum Restructuring in Higher Education After the Bologna Process: A New Pedagogic?" A monograph of a paper presented at The Third Conference on Knowledge and Politics at the University of Bergen, May 18-20th, 2005. *Revista Española de Educación Comparada,* 12 (2006), 255-284

Kearney, C. (2011), Efforts to Increase Students' Interest in Pursuing Science, Technology, Engineering and Mathematics Studies and Careers, Belgium: European School net (EUN Partnership AISBL) European Schoolnet's Member Countries - 2011 Report.

Kelly, A. V. (2004), The Curriculum: Theory and Practice (5^{th} ed.), London, Thousand Oaks and New Delhi, SAGE Publications.

Kerr. J. F. (1968), The Problem of Curriculum Reform: in Hopper, R. (1971), The Curriculum: Context, Design and Development, (pp. 178-200).

King, R., Marginson, S. & Naidoo, R. (eds.) (2011), Handbook on Globalization and Higher Education, UK: Edward Elgar Publishing Center.

Klein, M. F. (1992), A perspective on the Gap Between Curriculum Theory and Practice, Theory into Practice, Volume xxxi, Number 3, September 1992. Taylor & Francis.

Kliebard, H. M. (1976), Curriculum Past and Curriculum Present, Educational Leadership. Association for Supervision and Curriculum Development, 1976. http://www.ascd.org/ASCD/pdf/journals/ed_lead/el_197601_kliebard.pdf

Kliebard, H. M. (2004), The Struggle for the American Curriculum, 1893 – 1958, (3rd ed.), New York: RoutledgeFalmer.

Knoop, H (No Date), "Setting up Institutes of Technology at Ethiopian Universities". Information paper.

Koro-ljungberg, M. & Douglas, E.P. (2008), State of Qualitative Research in Engineering Education: Meta-Analysis of JEE Articles, 2005-2006, Journal of Engineering education, pp. 163-175, April 2008.

Kouwenhoven, W. (2009), Competence-based curriculum development in higher education: some African experiences.

Krathwohl, D. R. (2002), Theory into Practice, Volume 41, Number 4, Autumn 2002. Copy right © 2002 College of Education, The Ohio State University.

Krauss, S. E. (2005), Research Paradigms and Meaning Making: A Primer, The Qualitative Report Volume 10 Number 4 December 2005 758-770 http://www.nova.edu/ssss/QR/QR104/krauss.pdf University of Putra, Selangor, D.E., Malaysia.

Krefting, L. (1991), Rigor in Qualitative Research: The Assessment of Trustworthiness, The American Journal of Occupational Therapy, March 1991, Volume 45, Number 3.(pp. 214 -222)

Lahiff, A. (2009), Curricula Debate in Higher Education—an overview, University of Dublin, Trinity College.

Lathem. S. A., et.al. (2011), The Socially Responsible Engineer: Assessing Student Attitudes of Roles and Responsibilities, *Journal of Engineering Education*, July 2011, Vol. 100, No. 3, pp. 444–474, ASEE. http://www.jee.org.

Lattuca, L.R. & Stark, J.S. (2009), Shaping the College Curriculum: Academic Plans in Context (2nd ed.), JOSSEY-BASS: A Wiley Imprint, www.jossybass.com

Lattuca, R. et.al. (2006), The Changing Face of Engineering Education, The Bridge, Volume 36, Number 2, Summer 2006).

Learning Point Associates, (2009), Connecting Formative Assessment Research to Practice: An Introductory Guide for Educators.

Lefrançois, G. R. (2000), Theories of Human Learning: What the Old Man Said (4th ed.), USA: Wadsworth/Thomson Learning.

Lemlem, T. (2010), Review of Some Recent Literature: Identifying Factors that Affect Ethiopia's Education Crisis, *Ee-JRIF Vol 2, No 2 2010 - Education Issue: pp. 56-68*.

Leydens, J. A., Moskal, B. M. and Pavelich, M. J. (2004), Qualitative Methods Used in the Assessment of Engineering Education, Journal of Engineering Education, January 2004, pp. 65-72

Leydens. J. A. et.al. (1004), Qualitative Methods Used in the Assessment of Engineering Education, *Journal of Engineering Education*, January 2004 (pp. 65-72).

Longstreet, W.S. & Shane, H.G. (1993), Curriculum for a New Millennium, Boston: Allyn and Bacon.

Luiz, AG. et al (2004), The University-Industry Collaboration as a strategy for Engineering Education, In: Onwuka, E.N. (2009) Reshaping Engineering Education Curriculum to Accommodate the current Needs of Nigeria, Education Research and Review, Vol. 4(7), pp. 334-339, July, 2009. http://www.academicjournals.org/ERR

Lunenburg, F. C. (2011), Theorizing About Curriculum: Conceptions and Definitions. International Journal of scholarly Academic Intellectual Diversity, volume 13, Number 1, 2011.

Luxhøj, J.T. & Hansen. P.H.K. (1006), Engineering Curriculum Reform at Aalborg University *Journal of Engineering Education*, *(pp 183-186)*. July 1996

Essomba, M. A., Karatzia-Stavlioti, E., Maitles, H. and Zalieskiene, I. (2008), Developing the conditions for Education for Citizenship in Higher Education.

Marsh, C. J. (2006), Key Concepts for Understanding Curriculum (3rd ed.), London and New York: RoutledgeFalmer.

Marshall, C. & Rossman, G. B. (1999), Designing Qualitative Research (3rd ed.), SAGE Publications.

Marton, F. and Booth, S. (1997), Learning and Awareness, New Jersey: Lawrence Erlbaum Associates, Inc., Publishers

Matthews, C. M. (2007), Science, Engineering, and Mathematics Education: Status and Issues, CRS Report for Congress, Updated April 23, 2007.

McCaslin, M. L. & Scott, K.W. (2003), The Five-Question Method for Framing A Qualitative Research Study: The Qualitative Report Volume 8 Number 3 September 2003 447-461. http://www.nova.edu/ssss/QR/Qr8-3/mccaslin.pdf

McGee, C. (1997), Teachers and Curriculum Decision-making, Palmerston North: Dunmore Press.

McKernan, J. (1993), Challenges to the Public School Curriculum: New Targets and Strategies, University of Limerick.

McKernnen, J. (2008), Curriculum and Imagination: Process Theory, Pedagogy and Action Research, London and New York: Rutledge.

McKimm, J. (2007). Curriculum Design and Development, A paper written as part of the Deanery's web-based learning package for clinical teachers

McMillan, J. H. & Schumacher, S. (1993), Research in Education: A conceptual understanding, New York: HarperCollins.

Mekasha, K (2005), Ensuring the Quality of Ethiopian Higher Education in the Face of the Challenges of the 21st Century, The Ethiopian Journal of Higher Education, Vol. 2, No. 2 December 2005, pp. 103-130.

Merriam, S.B. (1998), Qualitative Study and Case Study Applications in Education. San Francisco: Jossey-Bass Publishers.

Meyer, J. W. (1977), The Effects of Education as an Institution. *American Journal of Sociology* 83, 1: 55-77.

Meyer, J. W., Francisco, O., Richard, R., and John Boli-Bennett (1977), "The World Educational Revolution, 1950-1970." Sociology of Education 50:242-58.

Mills, J. E. & Treagust, D. F. (2003), "Engineering Education – Is Problem-based or Project-based Learning the Answer?" Australasian J. of Engng. Educ., online publication 2003-04 http://www.aaee.com.au/journal/2003/mills_treagust03.pdf: The Australasian Association for Engineering Education Inc. ISSN 1324-5821

Minister of Civil Service, (2011), Directives to Provide for Autonomy of the Institutes of Technology at Addis Ababa University, (AAU Board, Directive No. 1/2003). http://www.aau.edu.et/aait/academics/school-of-electrical-and-computer-engineering/overview-of-ece/.

Ministry of Information, (1960), Speeches Delivered by His Imperial Majesty Haile Sellaaie 1st Emperor of Ethiopia on Various Occasions, May 1957 – December 1959, Addis Ababa: Commercial Printing Press.

Misganaw S., (2002), "Instructors Participation in Curriculum Decision - Making Process in Ethiopian Teacher Education Colleges" unpublished Thesis Presented to the school of Graduate Studies, Addis Ababa University.

MoE (1950), Imperial Ethiopian Ministry of Education Year Book, Eth. Cal. 1944-45 (1951-53).

MOE and Fine Arts, (1953) (1946 E. C.), A Ten – Year Program for the Controlled Expansion of Ethiopian Education, The Third Report) Addis Ababa, unpublished

MoE and Fine Arts, (1954a) (1946 E. C.), A Ten – Year Program for the Controlled Expansion of Ethiopian Education, The First Report) Addis Ababa, unpublished.

MoE and Fine Arts, (1955b) (1947 E. C.), A Ten – Year Program for the Controlled Expansion of Ethiopian Education, The Third Report) Addis Ababa, unpublished.

MoE, (1950), Imperial Ethiopian Ministry of Education Year Book, Eth. Cal.1940-41 (1947-48).

MoE, (1950), Imperial Ethiopian Ministry of Education Year Book, Eth. Cal. 1942-43 (1949-51).

MoE, (1980), New Educational Objectives and Directives for Ethiopia, Addis Ababa unpublished.

MoE, (1984), Education in Socialist Ethiopia: Origins, Reorientation Strategy for Development, Addis Ababa.

MoE, (1984), The Ethiopian School Syllabus, Ministry of Education of Socialist Ethiopia, Curriculum Department, unpublished.

MoE, (2001), Indicators of the Ethiopian Education System, Addis Ababa.

MoE, (2002), Higher Education Capacity Building Program, Main Document esdp-2 2002/03-2004/05 plan Addis Ababa

MoE, (2002), The Education and Training Policy and Its Implementation (Introduction, pp. 1 – 3 also, p. 11), February, 2002.

MoE, (2005), Ethiopian Higher Education Sector Capacity Building Strategy for 1998-2002 E.E. (2005-2009), Addis Ababa.

MoE, (2008), "Annual Intake and Enrollment Growths and Professional and Program Mix of Ethiopian Public Higher Education: Strategy and Conversion Plan, 2001-2005" (edited version) Unpublished paper.

MoE, (2010), Education Sector Development Program IV (ESDP IV) 2010/2011 – 2014/2015 2003 EC – 2007 EC Program Action Plan, Addis Ababa.

MoE, (2010), Education Statistics Annual Abstract 2002 E. C. (2009-2010 G.C), Addis Ababa: EMIS, Planning and Resource Mobilization Management Process

MoFED, (2002), Ethiopia: Sustainable Development and Poverty Reduction Program, Ethiopia, July, 2002, Addis Ababa.

MoFED, (2006), Ethiopia: Building on Progress. A Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06-2009/10), Volume I: Main Text.

MoFED, (2007), Ethiopia: Building on Progress: A Plan for Accelerated and Sustained Development to End Poverty (PASDEP), Annual Progress Report 2006/07, December, 2007, Addis Ababa.

MoFED, (2008), "The Engineering Capacity Building Program" in Ethiopia, Summary Version of the Evaluation, Evaluation Reports 039, July 2008.

MoFED, (2010a), Growth and Transformation Plan 2010/11 – 2014/15, Volume II: Policy Matrix, Ministry of Finance and Economic Development, November 2010, Addis Ababa.

MoFED, (2010b), Growth and Transformation Plan 2010/11 – 2014/15, Volume I: Main Text, Ministry of Finance and Economic Development, November 2010, Addis Ababa.

Molnar, A (1992), Contemporary Curriculum Discourse: Too Much Ado about Too Much Nothing, Theory into Practice, Volume xxxi, Number 3, Summer 1992.

Morell, L. (2007), Engineering Education, Globalization and Economic Development: Capacity Building for Global Prosperity, International Engineering Education Journal, October, 2007.

Morgan, H. and Houghton, A. (2011), Inclusive curriculum design in higher education: Considerations for effective practice across and within subject areas, Commissioned by Higher Education Academy https://www.heacademy.ac.uk/sites/default/files/resources/Introduction%20and%20overview.pdf

Morrow, R. M. (1994), Issues Facing Engineering Education, *Journal of Engineering Education, pp. 15-18, January 1994*.

Mourtos, N.J. (2013), Defining, Teaching, and Assessing Engineering Design Skills: in Industrial Engineering: Concepts, methodologies, Tools and Applications, U.S.A: IGI Global, pp. 1-17.

NEA, (2010), Global Competence in a 21st Century Imperative, Education Policy and Practice Department | Center for Great Public Schools | 1201 16th St., NW, Washington, D.C. 20036, 2010 (PB28A),

Nguyen, Duyen Q. (1998), The Essential Skills and Attributes of an Engineer: A Comparative Study of Academics, Industry Personnel and Engineering Students. Global J. of Eng. Educ., Vol. 2, No.1, © 1998 UICEE, Printed in Australia

Noumi, I. C. (2007), Theories of the Causes of Higher Education Systems and Higher Education System Changes, International Center for Higher Education Research, University of Kassel.

Olds, B. M., Moskal, B. H. & Milles, Ronald L. (2005), Assessment in Engineering Education: Evolution, Approaches and Future Collaborations, Journal of Engineering Education, January, 2005 (pp. 13 – 25).

Oliver & S. L. & Hyun E. (2011), Comprehensive Curriculum Reform in Higher Education: Collaborative Engagement of Faculty and Administrators, Journal of Case Studies in Education 2 (2011): 1-20, University of Massachusetts Boston

Oliver, S. L. & Hyun, E. (no date), Comprehensive curriculum reform in higher education: Collaborative engagement of faculty and administrators, Journal of Case Studies in Education http://www.aabri.com/manuscripts/10649.pdf (Accessed on 30th of Dec. 2012)

Olorunfemi, A.I & Ashaolu, M.O. (No date), A Pragmatic Approach in Engineering Education Teaching Methods and Industry Partnership, Lagos: Lagos State Polytechnic. http://www.sefi.be/wp-content/abstracts/1261.pdf (accessed on 25/03/2012).

O'Neil, J. (1994), The Challenge of Outcome-Based Education, Educational Leadership March 1994 | Volume **51** | Number **6,** (pp. 6-10), Aiming for New Outcomes: The Promise and the Reality, Association for Supervision and Curriculum Development

Onwuka, E.N. (2009), Reshaping Engineering Education Curriculum to Accommodate the Current Needs of Nigeria, Educational Research and Review Vol. 4(7), pp. 334 – 339, July 2009.

Ornstein, A. C. & Hunkins, F. P (1988), Curriculum: Foundations, Principles and Issues, Englewood Cliffs, New Jersey: Prentice Hall

Ornstein, A. C. (1987), The High School Journal, Vol. 70, No. 4(Apr. – May, 1987), pp. 2008-216.

Ornstein, A.C., Behar-Horenstien & Pajk, E.F (2003), Contemporary Issues in Curriculum (3rd ed.), Boston & New York: Parson Education, Inc.

Pacheco, J. A. (2012), Curriculum Studies: What is The Field Today? Journal of the American Association for the Advancement of Curriculum Studies - Volume 8, 2012.

Page, R. N. (2009), Foreword. In E. C. Short & L. J. Waks (Eds.), Leaders in Curriculum Studies: Intellectual Self-Portraits (pp. ix-xvi) Rotterdam: Sense Publishers.

Parkay, F.W., (2006), Curriculum Planning: A Contemporary Approach (8th ed.). Boston & New York: Pearson Education. Inc.

Parsons, J & Beauchamp, L. (2012), From Knowledge to Action: Shaping the Future of Curriculum Development in Alberta, Canada: the Crown in Right of Alberta.

Patton, M.Q. (2002), Qualitative Research and Evaluation Methods (3rd ed.). Thousand Oaks, CA: Sage.

Payton, O. D. (1979), Research: The Validation of Clinical Practice. Philadelphia: F. A. Davis.

Pearlma, M. (2006), in: Dwyer, Carol A. et al. A Culture of Evidence: Postsecondary Assessment and Learning Outcomes. ETS,

Perry, R. P and Smart, J. C. (eds.) (2007), Scholarship of Teaching and Learning in Higher Education: Evidence Based Perspective, Netherlands: Springer.

Petrina, S (2004), Interchange, Vol. 35/1, 81-126, Netherlands: Kluwer Academic Publishers.

Petrina, S. (2007), (edt.), Advanced Teaching Methods for the Technology Classroom, Mershey, London, Melbourne, and Singapore: Idea Group Inc.

Piaget, J. (1950), The Psychology of intelligence, London and New York: Routledge & Kegan Paul.

Pike, G. R. & Kuh, G. D. (2005), A Typology of Student Engagement for American Colleges and Universities, Research in Higher Education, Vol. 46, No. 2, March 2005, (pp. 185 – 209).

Pinar, W. F (1978), The Reconceptualization of Curriculum Studies, In: Flinders, D. J. & Thornton, S. J. (2004), The Curriculum Reader (2nd ed.), New York and London.

Polczynski, M. (2009), The Impact of Technology and Globalization on the Engineering Profession and Education, Proceedings of the 2009 ASEE North Midwest Sectional Conference

Popham, W.J, & Baker, E.L. (1970), Systematic Instruction, Englewood Cliffs, NJ: Prentice-Hall.

Population and Housing Census of Ethiopia (2007), Statistical Report at Country Level, Addis Ababa.

Prados, J. W (no date), Engineering Education in the United States: Past, Present, and Future, the University of *Tennessee.*

Prados, J. W. (1998), Action Agenda for Systemic Engineering Education Reform: Next Steps, Realizing the New Paradigm for Engineering Education Proceedings, pp. 1-27

Pratt, D. (1980), Curriculum Design and Development, New York: Harcourt Brace.

Prince M. J. & Felder, R. M. (2006), Inductive Teaching and Learning Methods:

Prince M. J. & Felder, R. M. (2007), The many Faces of Inductive Teaching and Learning, National Science Teachers Association (NSTA). Reprinted with permission from *Journal of College Science Teaching*, Vol. 36, No. 5, March/April 2007.

Punch, K. F. (2005), Introduction to Social Research: Quantitative and Qualitative Approaches (2nd ed.), London, Thousand Oaks, and New Delhi: SAGE Publications.

Raburn, R. (1993), Outcome-Based Education: Some Questions Addressed, OASCD Journal 5 (May 1993).

Rayner, P. "quality and Ideological Construct", in: the Proceedings of the Conference on the Future Direction of Higher Education in Ethiopia, pp. 109 – 130.

Reding, V. (2000), Two Decades of Reform in Higher Education in Europe: 1980 onwards (preface), Euryice Studies, The Information Network in Education in Europe

Report of the Education Sector Review, (1973). Education Challenge to the Nation. Part C., Technical Report.

Ritchie, J. & Lewis, J. (eds.) (2003), Qualitative Research Practice: A Guide for Social Science Studies, London, Thousand Oaks & New Delhi: SAGE Publications.

Ritz, J. M. (2009), A New Generation of Goals for Technology Education, Journal of Technology Education, Vol. 20 No. 2, (pp. 50-64) spring 2009.

Robertson, S. L. (2006), Globalization, GATS and Trading in Education Services, UK: Centre for Globalization, Education and Societies, University of Bristol.

Roffe, I. (2010).Sustainability of Curriculum Development for Enterprise Education, Education + Training, Vol. 52 Issue 2 pp. 140 – 164.

Rompelman, O. and Graaff, E. De (2006), The engineering of engineering education: curriculum development from a designer's point of view, European Journal of Engineering Education, Vol. 31, No. 2, May 2006, 215–226

Rugarcia, A., Felder, R. M., Woods, D. R., and Stice, J. E. (2000), The Future of Engineering Education: A Vision for A New Century, *Chem. Engr. Education*, *34*(1), 16–25 (2000).

Saint, W. (2004), Higher Education in Ethiopia: The Vision and Its Challenges, JHEA/RESA Vol. 2, No. 3, 2004, pp.83–113, Boston College & Council for the Development of Social Science Research in Africa, 2004.

Sampson, H. (2004), Navigating the waves: the usefulness of a pilot in qualitative research, In: Qualitative Research vol. vol. 4(3): Copyright © 2004, 383-402, London, Thousand Oaks, CA and New Delhi: SAGE Publications.

Santiago, P. et.al. (2008), Tertiary Education for the Knowledge society – OECD Thematic Review of Tertiary Education, Volume 1, OECD

SAQA (South African Qualification Authority) (2000), The National Qualifications Framework and Curriculum Development, http://www.saqa.org.za

Schofer, E. and Meyer, J. W (2005), The Worldwide Expansion of Higher Education in the Twentieth Century, American Sociological Review, Vol. 70, No. 6 (Dec., 2005), pp. 898-920, American Sociological Association, http://www.jstor.org/stable/4145399, Accessed: 07/01/2010

Schwab, J. J. (1964), Structure of the disciplines: Meanings and Significances, in Golby, M. et.al. (eds.) (1975) Curriculum Design (pp. 249 – 267) The Open University Press.

Schwab, J. J. (1969), The Practical: A language for Curriculum, in Flinders, D. J. & Thornton, S. J. (2004) The Curriculum Reader (2^{nd} ed.) pp. (103 – 117) New York and London

Schwab, J. J. (1978), The Practical: A language for curriculum. In J. Westbury & N. J Wilkof (eds), Science, curriculum and liberal education (pp. 287 – 321) Chicago: University of Chicago Press.

Schwab, K. (2010), The Global Competitiveness Report 2010–2011, Geneva: The World Economic Forum.

Schwartz, S. (2003), The Higher Purpose,

Schwarz, G. & Cavener, L. A. (1994), Outcome-Based Education and curriculum Change: Advocacy, Practice and Critique, Journal of Curriculum and Supervision 9, no. 4 (1994): 326-338

Shim, J. M. (2009), Violent Turbulence in Curriculum Theory and Practice, Journal of Curriculum Theorizing ♦ Volume 25, Number 1, 2009.

Slattery, P. (2006), Curriculum Development in the Postmodern Era (2^{nd} ed.) New York and London: Rutledge.

Smerdon, E.T (2000), An Action Agenda for Engineering Curriculum Innovation, A paper presented at the 11th IEEE-USA Biennial Careers Conference, November 2-3, 2000, San Jose, California .

Smith, M. K. (1996, 2000), Curriculum theory and practice the encyclopedia of informal education, www.infed.org/biblio/b-curric.htm.

Society of Professional Engineers (NSPE) (2013), Engineering Body of Knowledge, Prepared by the Licensure and Qualifications for Practice Committee of the National Society of Professional Engineers

Solomon A. (2010), Tension Between Massification and Intensification Reforms and Implications for Teaching and Learning in Ethiopian Public Universities, JHEA/RESA Vol. 8, No. 2, 2010, pp. 93–115, Council for the Development of Social Science Research in Africa 2010 (ISSN 0851–7762)

Solomon, A. (2008), Policy Formulation, Curriculum Development and Implementation in Ethiopia. Addis Ababa University Book Center.

Spady, W. G. & Marshall, K. J. (1991), integrating the Curriculum: Beyond the Traditional Outcome-Based Education, Educational Leadership, pp. 67-71, Association of supervision and Curriculum Development.

Spady, W.G. (1988), organizing for results: The basis of authentic restructuring and reform, Educational Leadership, October: 4-8, 1988.

Spencer, D. B. and Mehler, G. (2013), Opportunities in Engineering Education: Pathways to Better-Prepared Students, The BRIDGE, , National Academy of Engineering, Vol. 43, No. 2, Summer 2013 (pp. 24 – 30).

Spink, A & Mal, Jens-Eric (2013), Developing People's Information Capacities: Fostering Information Literacy in Educational Workplace & Community Contexts, UK: Emerald Group Publishing Limited.

Splitt, F. G. (2002), Environmentally Smart Engineering Education: A Brief on a Paradigm in Progress. Journal of Engineering Education, October, 2002 (pp. 447 – 450).

Splitt, F. G. (2003), The Challenge to Change: On Realizing the New Paradigm for Engineering Education. Journal of Engineering Education, April 2003.

Srivastava, A. & Thomson, S.B. (2009).Framework Analysis: A Qualitative Methodology for Applied Policy Research. JOAAG, Vol. 4. No. 2, pp. 72-79

Sryyedrezaie, S.H. (2013), Constructivism and Curriculum Development: International Journal of Sciences & Applied Research, Vol. 2(1), 62-67, 2013.

Stake, R. E. (2005), Qualitative Case Studies, In: Denzen, N.K. & Lincoln (eds.) (2005) The Sage Handbook of Qualitative Research (3rd. ed.) (pp. 443 – 466), Thousand Oaks, CA: sage

Stake, R.E. (1994), Case Studies. In: N.K. Denzin and Y.S. Lincoln (eds.), Handbook of Qualitative Research. London: SAGE Publications. pp. 236- 247.

Streveler, R. A. & Smith, K. A. (2006), Conducting Rigorous Research in Engineering Education, Journal of Engineering Education April 2006 (pp. 103 – 105).

Tadmor, Z. (2006), Redefining Engineering Disciplines for the Twenty-First Century, The Bridge, Vol. 36, No. 2, Summer 2006, (pp. 33-37) National Academy of Engineering.

Taba, H. (1962), Curriculum Development, New York, Chicago: Harcourt Brace. Jovanovich, Inc.

Taber, K.S. (2011), Constructivism as Educational Theory: Contingency in Learning, and Optimally Guided Instruction, In: Educational Theory, Jaleh, H. (ed.), (2011) pp. 39-61.

Talib1, F. et.al. (2010), The relationship between total quality management and quality performance in the service industry: a theoretical model. International Journal of Business, Management and Social Sciences Vol. 1, No. 1, 2010, pp. 113-128

Tanner, D & Tanner, T.N (1980), Curriculum Development: Theory into Practice. New York: Macmillan Publishing Co., Inc.

Tavner, A. (2005), Outcomes-Based Education in a University Setting, Australasian J. of Engng. Educ., Online Publication 2005-02, http://www.aaee.com.au/journal/2005/tavner05.pdf.

Taylor, P. (2001). 10 key stages towards effective participatory curriculum development, Zurich: Helvetas, Swiss Association for International Cooperation.

Teichler, U. (2004), “Changing Structures of the Higher Education Systems: The Increasing Complexity of Underlying Forces” Papers produced for the UNESCO

Forum Regional Scientific Committee for Europe and North America, Paris, March 2004 (ED-2006/WS/44).

Tekeste, N (2006), Education in Ethiopia: From Crisis to the Brink of Collapse, Sweden: Elanders Gotab AB, Stockholm.

Teklehaimanot, H. (1999). The Cultural Foundation of Education in Ethiopia, IER Flambeau, 7(1), 1-10.

Temechegn E, (2000), "What Research says About African Science Education" IER FLAMBEAU, Volume 8, Number 1, December 2000.

Terwel, J. (1999), Constructivism and its Implications for Curriculum Theory and Practice, J. Curriculum Studies, 1999, vol. 31, no. 2, 195 – 199, 0022 - 0272/99 , Ñ 1999 Taylor &Francis Ltd.

Terwel, J. (1999), Constructivism and its implications for Curriculum Theory and Practice, J. Curriculum Studies, 1999, Vol. 31, No. 2, 195 – 199.

Tesfaye T. & Kassahun K. (2009), Quality Assurance for Enhancement of Higher Education in Ethiopia: challenges faced and lessons learned,

Teshome, G. Wagaw (1979) Education in Ethiopia: Prospect and Retrospect, Ann Arbor: The University of Michigan Press.

Teshome, Y. (2005), Ethiopian Higher Education Sector Capacity Building Strategy for 1998-2002 E.C. (2005-2009), Ministry of Education, Addis Ababa.

Teshome, Y. (2007), The Ethiopian Higher Education: Creating Space for Reform, St. Mary's UC Printing Press.

Tessmer, M. & Richey, R. C. (1997), The Role of Context in Learning and Instructional Design, ETR&D, Vol. 45, No. 2, 1997, pp. 85-115, ISSN 1042-1629.

Tierney, W. (1995), Cultural Politics and the Curriculum in Postsecondary Education; In J. Haworth & C Conrad (eds.). Revisioning Curriculum in Higher Education. Needham Heights, MA: Simon and Schuster.

Toombs, W. and Tierney, W. (1991), Meeting the Mandate: Renewing the College and Departmental Curriculum. ASHE-ERIC Higher Education Report No. 6, 1991, http://files.eric.ed.gov/fulltext/ED345603.pdf.

Trevelyan, J (2010), Mind the Gaps: Engineering Education and Practice, Proceedings of the 2010 AaeE Conference, Sydney.

Trotskovsky, E. Sabag N. (2014), Internship Project - Design in Industry vs. Research in Academia – A case study. Journal of International Scientific Publications Educational Alternatives ISSN 1314-7277, Volume 12, 2014, www.scientific-publications.net

Trudeau, (1964) Higher Education in Ethiopia, Montrial, A doctoral project

Tyler, R. (1969), Educational Evaluation, New Roles, New Means. The Sixty – eights Year Book of Education. Chicago: University of Chicago Press.

Tyler, R. W. (1949), Basic Principles of Curriculum and Instruction, Chicago and London: The University of Chicago Press.

UNESC, (2006), Bridging the Technology gap Between and within Nations, Report of the Secretary General, Commission on Science and Technology for Development, Ninth session Geneva, 15–19 May 2006

UNESCO Expert Group, (1995), Strategic Issues in Engineering Education in Africa, Report of the Expert Group Meeting on Engineering Education in Africa, Nairobi, Kenya.

UNESCO, (1998a), The World Declaration on Higher Education for the Twenty-First Century: Vision and Action, adopted by World Conference in 1998, http://www.unesco.org/education/educprog/wche/declaration_eng.htm.

UNESCO, (1998b), Higher Education in the Twenty-first Century Vision and Action, UNESCO, Paris, 5–9 October 1998

UNESCO, (2010), Engineering: Issues, Challenges and Opportunities for Development, France: United Nations Educational, Scientific and Cultural Organization.

United Nations University, (2009), Revitalizing Higher Education in Sub-Saharan Africa, a United Nations University Project. www.unu.edu/africa

Varghese, N. V. (2008), Contribution of higher education and research to education for all (EFA), paper commissioned for the EFA Global Monitoring Report 2009, Overcoming Inequality: why governance matters”.

Vrasidas, C. (2000), Constructivism versus objectivism: Implications for interaction, course design, and evaluation in distance education. International Journal of Educational Telecommunications, 6(4), 339-362.

Vygotsky, I. (1978), Mind in Society: The Development of Higher Psychological Processes, Cambridge, MA: Harvard University Press.

Wang, V. C. X. and King, K. P. (2009), Building Workforce Competencies in Career and Technical Education. A Volume in Adult Education Topics: Theory, and Practice in Lifelong Learning, U.S.A.: Information Age Publishing.

Wankat, P. C. and Oreovicz (1993), Teaching engineering, McGraw-Hill,

Wiedmaier-Pfister, M., Dagnew, G., Wolday A., Mommartz, R., Duflos, E., and Steel, W. (2008), Access to finance in Ethiopia, Sector assessment study, Volume 2, for the German Technical Cooperation within the Engineering Capacity Building Project

Wilczynski, V. and Douglas, S. M. (1995), Integrating Design across the Engineering Curriculum: A Report from the Trenches, *Journal of Engineering Education*, pp. 235-240

Wiles, J. & Bondi, J. (1989), Curriculum Development: A guide to Practice (3rd ed.), New York: Merill, an imprint of Macmillan Publishing Company.

Wondwessen, K (2006), in AAU Faculty of Technology Curriculum Reform, Introduction, Book one, "Forward"

Woollacott, L. (2007) A Rationale for a Universal Document Based on the CDIO Syllabus and the Taxonomy of Engineering Competencies, Proceedings of the 3rd International CDIO Conference, MIT, Cambridge, Massachusetts, June 11-14, 2007 Johannesburg University of the Witwatersrand.

World Bank (2010), Financing Higher Education in Africa, Washington, D.C.: The International Bank for Reconstruction and Development.

World Bank, (2000), Higher Education in Developing Countries: Peril and Promise, Washington, D.C.: The International Bank for Reconstruction and Development / THE WORLD BANK.

World Bank, (2007), Higher Education Quality Assurance in Sub-Saharan Africa: Status, Challenges, Opportunities and Promising Practices, Washington D.C.: World Bank.

Woube K. (2000), The Need for Analyzing Culture in Planning Curriculum, IER FLAMBEAU, Volume 11, Number 2, June 2004.

Wray, M. (2013), Developing an inclusive culture in higher education: final report. York: Higher Education Academy.

Wuhibegezer F. (2013), Historical evolution and the dynamics of modern education in Ethiopia, Journal of Educational Research and Studies Vol.1 (5), pp. 40-49, October, 2013, ISSN: 2329-3039, Peak Journals

Wulf, W.A. (1998), The Urgency of Engineering Education Reform, In: Realizing the New Paradigm for Engineering Education, Proceedings, June 3-6, 1998, pp. 28-30.

Wulf, W.A. (1998): In Realizing the New Paradigm for Engineering Education: Proceedings, January 3-6, 1998, pp 28-30. New York: Engineering Foundation Conferences, Three Park Avenue.

Yin, R. K. (1999) Enhancing the Quality of Case Studies in Health Services Research, HSR: Health Services Research 34:5 Part II (December 1999).

Yin, R. K. (2003), Case Study Research (3rd ed.), Thousand Oaks, London and New York: SAGE Publications

Yuan, R. (2004), The Globalization of Science and Engineering Studies. Advance proof, copyright 2004 COSMOS JOURNAL.

Appendices

Appendix A—Consent Form

Interview Protocol for the Research entitled "Curriculum Development Process of the New Engineering Education Program in Ethiopia"

Consent Form

University/Institute: ___________________________________

Name of Interviewee: ____________________ Title: _______________ Date: _________

Department: ______________________ Years of Service: ______ Phone: ___________

Interviewed By: ____

This interview is designed to solicit information about the process and practice of the engineering curriculum development, practices and its constituents, how it is perceived within the higher education institutions including information about the nature, characteristics, opportunities and challenges in its implementation. The goal is to locate, illuminate, and understand the distinctive values, specific practices, and skills which lend the engineering curriculum development validity. In other words I am interested in understanding more about what is happening when we are at our best.

The information you provide in this interview will be used only for the purpose of the research identified above and by no means jeopardize your private personality as a result of breaking confidentiality. My interest is in learning from your experience. The collected comments, experience and suggestions from you and others will be summarized, coded, and analyzed to full-fill the intention of improving the engineering Curriculum Development process.

Thank you in advance for your willingness to be interviewed

Mesfin Sileshi

PhD candidate

I have read the consent form and recognize that my participation in this study is entirely voluntary and that I am free to withdraw at any time during the course of the study without consequence. I understand that my information resulting from this study will be strictly confidential. I realize that I may ask for further information about this study if I wish to do so at any time.

I have received a copy of this consent form for my own records. I agree to participate in this study.

____________________________ Date _____________________

Participant's Signature

Appendix B—Sample Interview questions

No.	Research Question	Strategies for data collection	Sample of Leading questions for the interview & the focus group discussion
1.	Why was the engineering curriculum reform initiated? How was it developed?	Interview Document analysis	What were the main reasons that led to the reform of engineering education and curriculum? Who was involved in the curriculum development? How was your role and involvement in the curriculum development?
2.	How do deans, teachers and students view and describe engineering curriculum and the congruency between the curriculum expectations and its implementation?	Document analysis Interview Focus group	How do you characterize/perceive the new engineering curriculum? What were your expectations in terms of the teaching/learning process, assessment, outputs? And why? How does your role as a teacher influence the curriculum development process and its practices in the field of studies you are teaching? Do you think the assessment of student's performance of the knowledge and skills/competencies is done effectively? If so, How? If not, why?
3.	What are the factors that influenced engineering curriculum development and its practices?	Interview Focus group Documents	What do you think is very important in engineering education for a student to be successful? And how do you make it happen as a teacher? How do you characterize the teaching learning process and the assessment mechanism in the field of study you are teaching? Why?
4.	How do employers assess their involvement in curriculum design process and in its relevance? What are their expectations of the new engineering graduates in terms of their knowledge, skills, and competencies?	Interview Documents	Have you or any member of your company, in the past, involved in making suggestions on engineering education and/or curriculum development? Please elaborate. How do you characterize engineering graduates who are newly employed in your company with regard to their knowledge and skills/competencies? Please elaborate. What is your idea of engineering education and curriculum provided within the educational institutions and how can your industry contribute in this regard?

Appendix C—Permission to ASTU

አዲስ አበባ ዩኒቨርሲቲ
ሥነ ትምህርት ኮሌጅ
የሥርዓተ ትምህርት መምህራን
ሙያ ልማት ትምህርት ክፍል

Addis Ababa University
College of Education
Department of Curriculum
And Teacher Professional
Development Studies

☎ 239716 ✉ 1176 Fax: 00251(11) 242719 e-mail:

Date 26 Oct 2011

To: Whom It May Concern

Ato Mesfin Sileshi is a PhD student at Addis Ababa University. He/she is working on a research project entitled.
Curriculum Development Process, Perceptions Of Stakeholders on Engineering.

I would be most grateful if you extend to him/her all the necessary assistance regarding this Matter.

Thank you for your kindness

Sincerely

GebreEgziabher Debeb
Chairperson, Department of Curriculum and
Teachers Professional Development Studies

TO Engineering School
p/s assist him

Tolla Berisso Geda (Dr.)
Academic Vice President
17/01/13

To. Civil Eng. Dep't
Electrical Eng.
Mechanical Eng.
Please show your good support

Appendix D—Permission to AAiT

Appendix D—Permission to AAiT

Addis Ababa University
College of Education and Behavioral Studies
Department of Curriculum & Teacher Professional Development Studies

219716   1176   Fax: 00251(1) 219716   e mail:

Date February 8, 2013

To: Whom It May Concern

Mesfin Sileshi is a PhD student at Addis Ababa University. He/She is working on a research project entitled.
Curriculum Development Process and Practices of the New Engineering Education Program in Ethiopia

I would be most grateful if you extend to him/her all the necessary assistance regarding this Matter

Thank you for your kindness

Sincerely

Getachew Adugna, (PhD)
Chair, Department of Curriculum and Teachers Professional Development Studies

please assist Mr. Mesfin in his research work by facilitating those whom he wants to interview

Appendix E—Permission to BiT

አዲስ አበባ ዩኒቨርሲቲ
ሥነ ትምህርትና ጠባይ ጥናት ኮሌጅ
የሥርዓተ ትምህርት መምህራን ሙያ
ልማት ትምህርት ክፍል

Addis Ababa University
College of Education and Behavioral Studies
Department of Curriculum & Teacher Professional Development Studies

☎ 239716 ✉ 1176 Fax: 00251(1) 239716 e-mail: tecs.aau@telecom.net.et

Date February 8, 2013

To: Whom It May Concern

Mesfin Sileshi is a PhD student at Addis Ababa University. He/She is working on a research project entitled.

Curriculum Development Process and Practices of the New Engineering Education Program in Ethiopia.

I would be most grateful if you extend to him/her all the necessary assistance regarding this Matter.

Thank you for your kindness.

Sincerely

Getachew Adugna, (PhD)
Chair, Department of Curriculum and Teachers
Professional Development Studies

To: School of
1 Civil and Water Reso
2. Mechanical and In
3. Electrical and Comp

for your corpora
7689 of
76 5720
918 765360 Solomon T

Appendix F—Permission to Industry

ኢሌክትሪክ ኃይል ኮርፖሬሽን
ETHIOPIAN ELECTRIC POWER CORPORATION
ውስጣዊ ማስታወሻ

INTERNAL MEMORANDUM

ቁጥር፡ ሰ.ኃ.ሥ/175/2005

ቀን፡ ሚያዚያ 09 ቀን 2005 ዓ.ም.

ለ፡ ጀነሬሽን ኮንስትራክሽን አስተዳደርና ፋይናንስ ቢሮ

ለ፡ ትራንስሚሽን ሰብስቴሽን ኮንስትራክሽን አስተዳደርና ፋይናንስ ቢሮ

ለ፡ ለአገር አቀፍ ኤሌክትሪክ አቅርቦት ፕሮግራም አስተዳደርና ቢሮ

ከ፡ ሰው ኃይል ሥልጠናና ልማት ቢሮ

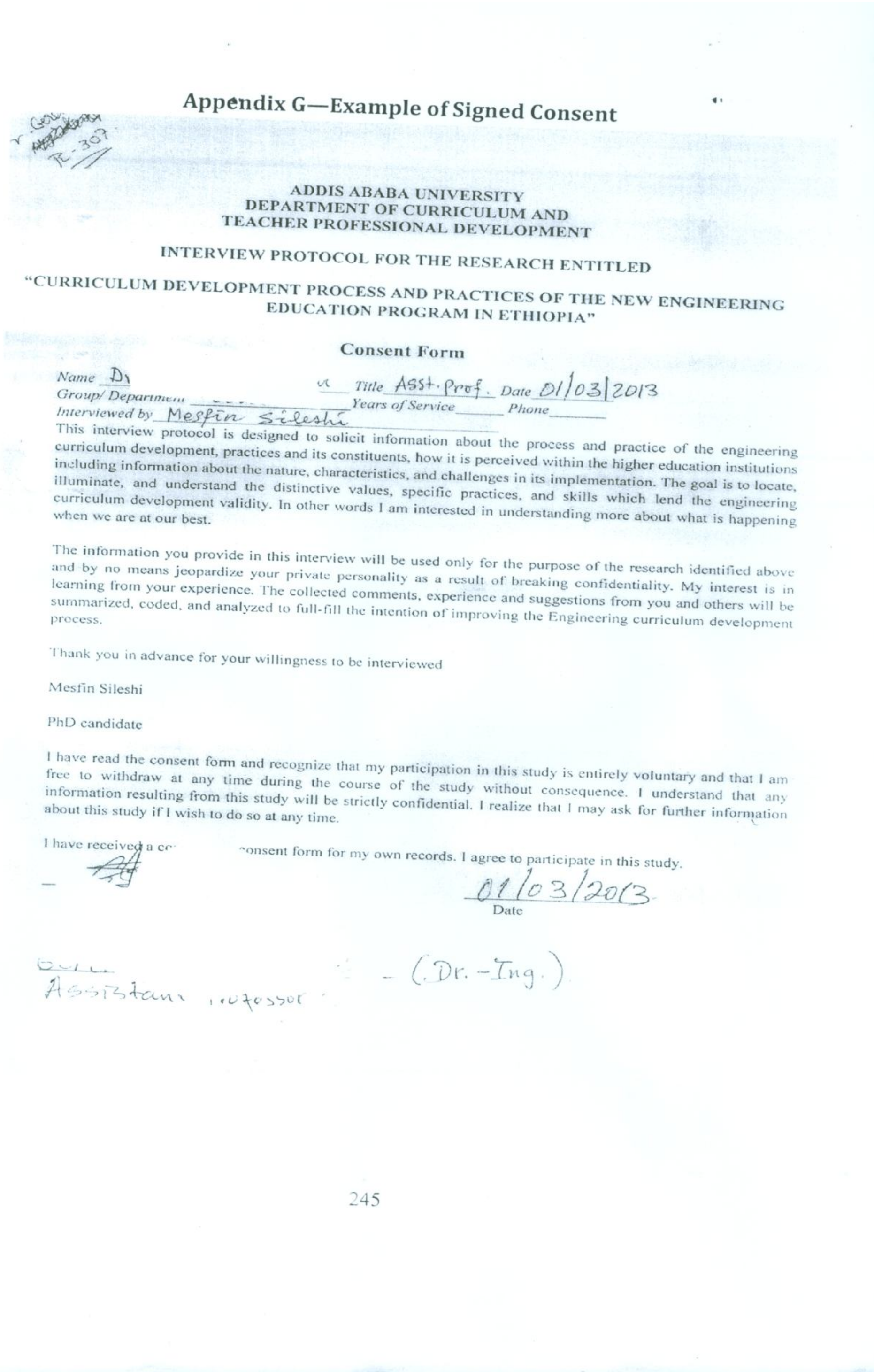
ቃሬቀኝ አላምረው

ጉዳዩ፡- ለዩኒቨርስቲ ተማሪ ለምርምር የሚረዳ መረጃ ትብብርን በተመለከተ፣

የአዲስ አበባ ዩኒቨርስቲ የPHD ተማሪ የሆኑት አቶ መስፍን ስለሽ Curriculum Development process and practices of the new Engineering Education in Ethiopia በሚል ርዕስ ለሚያደርጉት ጥናት የሚያስፈልጋቸውን መረጃ እንዲሰጣቸው የአዲስ አበባ ዩንቨርስቲ ስነ-ትምህርትና ጠባይ ጥናት ኮሌጅ የሥርዓተ ትምህርት መምህራን ሙያ ልማት ትምህርት ክፍል ጠይቋል፡፡ ስለሆነም በእናንተ በኩል የሚፈልጉትን መረጃ ማግኘት እንዲችሉ አስፈላጊው ትብብር እንዲደረግላቸው እንጠይቃለን፡፡

የሰው ኃይል ሥልጠናና ልማት ቢሮ
Tel 011-6463317 011-6463316 ጠይቃ" 011-6463470 Ex. 209,211& 214
D:\ Memo 2005

Appendix G—Example of Signed Consent



Appendix G—Example of Signed Consent

ADDIS ABABA UNIVERSITY
DEPARTMENT OF CURRICULUM AND
TEACHER PROFESSIONAL DEVELOPMENT

INTERVIEW PROTOCOL FOR THE RESEARCH ENTITLED

"CURRICULUM DEVELOPMENT PROCESS AND PRACTICES OF THE NEW ENGINEERING EDUCATION PROGRAM IN ETHIOPIA"

Consent Form

Name Dr ... *Title* Asst. Prof. *Date* 01/03/2013
Group/ Department ______ *Years of Service* ______ *Phone* ______
Interviewed by Mesfin Sileshi

This interview protocol is designed to solicit information about the process and practice of the engineering curriculum development, practices and its constituents, how it is perceived within the higher education institutions including information about the nature, characteristics, and challenges in its implementation. The goal is to locate, illuminate, and understand the distinctive values, specific practices, and skills which lend the engineering curriculum development validity. In other words I am interested in understanding more about what is happening when we are at our best.

The information you provide in this interview will be used only for the purpose of the research identified above and by no means jeopardize your private personality as a result of breaking confidentiality. My interest is in learning from your experience. The collected comments, experience and suggestions from you and others will be summarized, coded, and analyzed to full-fill the intention of improving the Engineering curriculum development process.

Thank you in advance for your willingness to be interviewed

Mesfin Sileshi

PhD candidate

I have read the consent form and recognize that my participation in this study is entirely voluntary and that I am free to withdraw at any time during the course of the study without consequence. I understand that any information resulting from this study will be strictly confidential. I realize that I may ask for further information about this study if I wish to do so at any time.

I have received a co... consent form for my own records. I agree to participate in this study.

01/03/2013
Date

Assistant Professor (Dr.-Ing.)

245