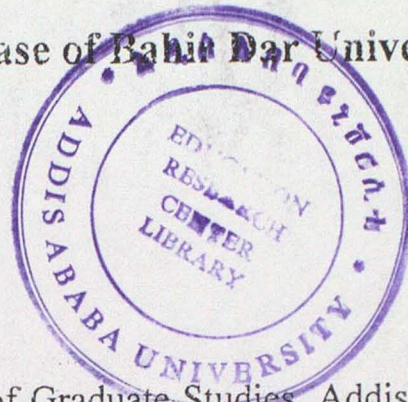




**Learners' Environmental Literacy in Relation to Knowledge,  
Attitude and Practice: The Case of Bahir Dar University**

**By Taye Alamirew Enyew**



A Thesis presented to the School of Graduate Studies, Addis Ababa University  
in Partial fulfillment of the requirements for the Degree of Masters of Arts (MA)  
in Educational Research and Development

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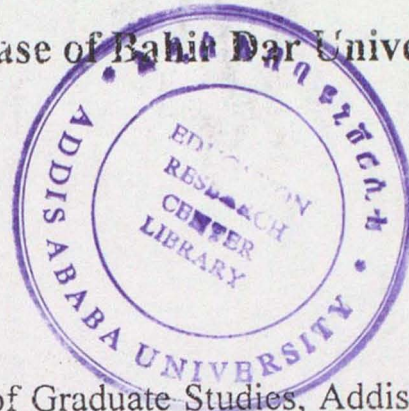
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Taye 2008

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## ACRONYMS

- AAU – Addis Ababa University  
BDU – Bahir Dar University  
EE – Environmental Education  
EL – Environmental Literacy  
ELS - Environmental Literacy Survey  
EPA - Ethiopian Environmental Protection Authority, Ethiopia  
US-EPA - US Environmental Protection Agency  
EETAP -Environmental Education and Training Partnership  
FDG- Focus Group Discussion  
FOE – Faculty of Education  
GEQAEA-General Education Assurance and Examination Agency  
IER – Institute of Educational Research  
MOE – Ministry of Education, Ethiopia  
NAAEE - National American Association for Environmental Education  
NEP - New Environmental Paradigm  
NEPS - New Ecological Paradigm Scale  
NGO - Nongovernmental organization  
OC- observer’s comment  
One- ANOVA- one way analysis of variance  
PCA- principal component analysis  
TPB – Theory of Planned Behavior  
TRA – Theory of Reasoned Action  
UNCED - United Nations Conference on Environment and Development  
UNEP - United Nations Environment Programme  
UNESCO - United Nations Educational, Scientific and Cultural Organization

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Appendix I- Sample size determination formula

## Abstract

*Today more than ever, students need high-quality environmental education programs that succeed in moving values, developing favorable attitudes and changing behaviors' in the direction of sustainability and environmental conservation. Environmental action begins with environmental literacy.*

*Hence, the objectives of the study were to (a) analyze undergraduate regular University students' environmental literacy - knowledge, attitudes, practice- and (b) examine the relationship between participants' knowledge, attitudes, and commitment to environmental friendly behavior along with some biographical and academic variables.*

*A descriptive survey method supplemented by some qualitative approach was employed. Participants were 302 (39.1% geography, 32.8% biology, and 28.1% chemistry) from year I and year III selected by proportional stratified sampling technique from natural science (chemistry, biology), and social science (geography). Departments were selected purposefully. Mainly a questionnaire consisting of environmental knowledge, attitudes and practice was the main data gathering tool from students. Data was analyzed using both descriptive (percentile, mean, standard deviation) and inferential (simple correlation, independent T-test, one way ANOVA, PCA and linear regression) statistics.*

*Results show that (1) undergraduates at BDU have a moderately favorable environmental attitude (62.3% = grade C) followed by nearly moderate environmental knowledge (52.4% = grade C) but below average in environmentally friendly practices engagement (46.1% = grade D); 2) a very low relationship ( $r < 0.2$ ) among components of environmental literacy; 3) an increase in environmental literacy as students growing older as well as moving up from year one to three; 4) males, with rural background and social science streams had higher scores than the corresponding females, with rural backgrounds and natural sciences in overall environmental literacy index.*

*On the basis of findings and discussions, conclusions and implications for further research are well indicated.*

## **Chapter One: Introduction**

### **1.1. Background of the Study**

Not only nature has enriched us with innumerable resources such as –air, water and various kinds of minerals, but also evolution has blessed us with the faculty of choice and free will to become active agents in the evolutionary process. As a result of free will and unlimited needs, human beings are doing excessive exploitation of natural resources for the sake of industrializations and implementation of several plans of development that have resulted in to utter neglect of the preservation of the natural environment (Chaube and Chaube 2005). That is, the environment, while highly valued by most, is used and altered by a wide variety of people with many different interests and values. Difficulties remain on how best to ensure the protection of our environment and natural resources for sustainable development.

For instance, a global overview of the 20<sup>th</sup> century reminds us that it was marked by: (1) two devastating world wars; (2) rapid advances in science and technology, from the first airplane flight at Kitty Hawk, North Carolina (US) to the landing on the moon; (3) a sharp rise in living standards in North America, Europe, and Japan; (4) the politics of environment, including loss of forests, shortages of energy and water, the decline in biological diversity, and air pollution; (5) the onset of the AIDS epidemic; and (6) The planet's population continues to explode: from 1 billion in 1820, to 2 billion in 1930, 3 billion in 1960, 4 billion in 1974, 5 billion in 1988, and 6 billion in 2000 per the planet,earth that has incredible impact, directly or indirectly, on the natural environment (The world Fact book 2007).

Specifically in Ethiopia: introduction of modern education in 1908 (Abebayehu, 1998); land degradation challenges to the extent that is difficult to reverse in the northern, and eastern part of the country being early dwellers (Demil 2003); unsystematic farming (EPA 1997); washing away of fertile top soil, and frequent draughts (Beletu and Yesuf,1990); explosions of population from 12 million in 1912 to 67 million in1994 to 83 million (projected) in 2007

(CSA 1994); reduction of forest from 40% to less than 3% (Ayele 2003), are some of the dramatic features just before catching up the new Ethiopian millennium .

More people means more consumption, greater demand for resources, and more environmental balance deterioration .That's why Russell (1988) summarizes, in a broad sense, that the nuclear threat, the greenhouse effect, the destruction of the rain forests, the wide scale extinction of species, acid rain, soil erosion, the depletion of the ozone layer, the problem of atomic waste, pollution, the energy crisis, the economic crisis, the food crisis, the water crisis, the housing crisis, the sanitation crisis, the AIDS crisis, and all the many other crises that humanity faces are all the consequence of unlimited human needs over limited natural resources suggesting ,with no exaggeration ,that we are living through the most exciting and challenging times ever in human history .

According to Trainer (1995a), the impact we have on the environment (I) can be thought of as due to the number of people we have (P), multiplied by their per capita level of consumption, or affluence (A), multiplied by the sort of technology (T) in use (for instance heating a house by fossil fuels has a bigger impact than heating by solar passive design) equated as  $I = P \times A \times T$ . By far, the third world's environmental problems, according to this dominant perspective, could be seen as arising first and foremost from population growth rather than technology or affluence while the West's chief environmental problem, in contrast, was attributed neither to its population growth nor its technology (areas in which it had comparative environmental advantages), but to its affluence or luxury life and the growing burden that this imposed on the environment.

In another perspective, while the advocates of "*Environmentally Sustainable Development*" usually believe that all we need to do to solve the environmental and resource problems is to have: tighter pollution control, buy products that are recyclable, and design more energy efficient products, etc, the "*limits to growth*" advocates argue that there is no chance of solving the major global problems we face unless we go much further and drastically reduce the amount of producing and consuming going on, because the problems are essentially due to the very high levels of resource use and waste involved in our way of life. That is ,an

ecologically sustainable society can move forward if people have materially simple lifestyles, in highly self-sufficient local economies that are run mostly through cooperative arrangements, in a quite new economy; one that is not driven by the profit motive and market forces and including zero economic growth (Trainer, 1995a, 1999). That's why the atmospheric scientists have been telling us for years that if India and China insist on pursuing the western development model they will have to burn their large resources of dirty coal, for the purpose of satisfactory development in terms of high levels of industrialization and consumption, causing a far worse environmental (greenhouse) problem than we have now (Brown, 1990).

Hollander (2003), also from economic perspective, contends that the most critical environmental problem is global poverty. He argues the case that the essential prerequisite for sustainability is a global transition from poverty to affluence, coupled with a transition to freedom and democracy. That it is *poverty should be addressed, both for the environment and for moral reasons, and that science, technology, markets, and affluence are the friends of the environment and poverty is the enemy*. In other words; economic development and technological advances can relieve such problems as food shortages, deforestation, air pollution, land degradation, and provide clean water, adequate energy supplies, and improved public health. To Hollander, technological change can lower environmental impact by reducing the materials and energy used per unit of output and substituting less harmful technology.

Educators, on their own behalf, also assert that the first step in coping up environmental problems is to develop an environmentally-conscious society through formal or non formal environmental education - a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address these challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action .

It was with such [paradoxical] back ground that the first United Nations' Conference, as a landmark in the history of Environmental Education (EE) at the international level on the Human Environment held in Sweden (Stockholm-72), which strongly expressed the need for an international framework for the development of EE (UN 1972).

Following up on the recommendations of this conference, a series of regional and sub-regional meetings on EE were organized worldwide in the succeeding years, culminating in the International Workshop on Environmental Education (Belgrade-75) and the launch of the International Environmental Education Programme (IEEP) jointly by UNESCO and UNEP (UNESCO 1976).

One of the major recommendations of this workshop was to convene an international conference on EE specifically addressed to policy and decision makers in education. Thus, the major objective of the Intergovernmental Conference on Environmental Education, organized by UNESCO in co-operation with UNEP (Tbilisi-77), was to make recommendations to participating Member States to enable them individually to adopt national policies promoting EE (UNESCO, 1978).

Ten years later, in 1987, UNESCO and UNEP organized an International Congress in Moscow, USSR, in order to determine an international strategy for action in EE and training for the 1990s.

Five years later, to assess 20 years of work in the field of environment following the 1972 Stockholm conference, the UN organized a Conference on Environment and Development (UNCED), also called the Earth Summit at Rio de Janeiro, Brazil (UNCED 1992).

The outcomes of this conference were crystallized in Agenda 21, whose Chapter 36, entitled "Promoting Education, Public Awareness and Training", established the basis for action in EE for Sustainable Development for the years to come.

As stated in *Agenda 21*, the document produced by the 1992 UNCED, education is "critical for promoting sustainable development." Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their

own needs (Brundland, 1987). Understanding the principles of sustainability and the interdependence of the environment, the economy, and social systems can help us learn to make the changes necessary to become effective stewards of natural resources and the environment.

Therefore, education, unlike the previous eras should not focus on transmitting cultural values and preparing for the world of work rather “ sustainable education, environmental education in particular, should be constructed on four pillars: *learning to know, learning to do, learning to be and learning to live together*”(UNESCO cited in Damtew,2007).

Historically, various conferences and organizations have offered definitions of EE. For instance, UNESCO and UNEP define EE as "a permanent process in which individuals gain awareness of their environment and acquire the knowledge, values, skills, experiences, and also the determination which will enable them to act--individually and collectively--to solve present and future environmental problems"(UNESCO, Tbilisi Declaration, 1978). Under some of these definitions, EE includes the economic, environmental, and social dimensions contained in the concept of education for sustainability.

It is generally agreed that EE is a process that creates awareness and understanding of the relationship between humans and their many environments - natural, man-made, cultural, and technological. It is concerned with knowledge, values, and attitudes, and has as its aim responsible environmental behavior.

Environmental literacy (EL) has traditionally been defined as a goal of EE. This view is based on numerous declarations of some of the key international conventions in the history of EE.

An example is the charter developed at a workshop sponsored jointly by the UNESCO/UNEP in Belgrade, Yugoslavia in October 1975, that declares:

*“EE is a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, attitudes, motivations, commitments, and skills to work individually and collectively towards solutions of current problems and the prevention of new ones.”*

As is evident from this declaration, environmental literacy is considered a major prerequisite for making better environmental decisions by any society of the world.

Disinger and Roth (1992) suggest that environmental literacy is essentially the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems.

Roth (1992) is also of the opinion that “environmental literacy should be defined . . . in terms of observable behaviors. That is, people should be able to demonstrate in some observable form what they have learned — their knowledge of key concepts, skills acquired, disposition toward issues, and the like”.

The citizenry addressed in these definitions includes learners from all sectors of society who can be approached through many channels, more specifically formal and non formal education programs. The challenge for educators is to provide meaningful educational learning experiences that help raise awareness in order to foster environmental ethics that will have long lasting impacts. There are seven variables that foster environmental literacy: (1) knowledge of issues, (2) beliefs concerning issues, (3) individual values, (4) individual attitude, (5) locus of control, (6) environmental sensitivity, and (7) knowledge and skill of environmental action strategies Sia (1985/1986). The responsibilities of environmental educators, thus, include development of an environmentally literate society capable of internalizing issues and making decisions based on real perspectives.

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The development of environmental literacy is a multi-step process that begins with knowledge and results in active citizen participation. The knowledge component is based on the idea that before an individual can act on an environmental problem, that individual must understand the environmental problem (Hines, et. al. 1986/1987). The knowledge base is comprised of two key aspects- knowledge of ecological systems and knowledge of social and human impacts on the environment. More specifically, the development of knowledge includes the development of an individual's values and attitude- helping an individual realizes his or her personal values and attitude toward environmental issues. The concepts of individual and group locus of control must also be addressed in the knowledge development.

The final step in the process is using citizen action to work towards solutions of the identified environmental issue, which involves two key activities. First, the individual must apply his or her knowledge by investigating and evaluating environmental issues and potential solutions is fundamental to citizen action. Second, the individual must chose which course of action is best in the given situation. EE is the vehicle for developing environmental literacy.

The goal of EE is to develop an environmentally literate citizenry, thus EE focuses on empowering individuals to deal effectively with positive and negative relationships between people and their environments. If we accept the premise that all citizens need to have some level of environmental literacy in order to demonstrate responsible environmental behavior for sustainable future, then the need to explore and define existing levels of environmental literacy at various level of schooling is the duty and responsibility of researchers and educators as the issue has not yet get research attention in spite of the importance of the issue in Ethiopian context.

It is this reality that initiates the researcher to conduct the study at hand at tertiary level since Colleges and Universities have been not only acknowledged by education policy (MOE, 1994) to “bring up citizens who can take care and utilize resources wisely” but also challenged by international mandates, of which Ethiopia adopted, such as Agenda 21 to increase their role in developing environmental literacy in all graduates (UNCED, 1992).

The purpose of this study is, therefore, to examine the knowledge, attitude and practice of undergraduate University, Education Faculty, students about Environmental Literacy as core requirement for sustainability.

### *1.2. Statement of the problem*

Human beings live in an era of unprecedented growth and change so that every facet of people daily lives has been changed by technology-from how people work, travel, and obtain food, to recreating and maintaining social relationships. However; in developing countries, the rapidly growing populations along with its needs usually take precedence over those of its surroundings with little regard for the environment. For example degree of deforestation, land degradation and excessive loss of fertile top soil in rural areas and industrial waste release, pollution, ground water deflation in urban areas are some of the pressing problems facing Ethiopia today (Beletu and Yesuf 1990). Moreover; resettlement programs that the Ethiopian government is taking every year in rural areas, presence of environmental refugees and rural to urban migration of people are good indicators that the environment is seriously degraded to the extent that it cannot support dwellers in some part of Ethiopia.

In order to prevent such large scale disaster in the near future there is need for a multidisciplinary and integrated approach targeting aspects such as technology, law, economics, socio-culture, ecology, and politics. Equally there is need for change of attitude, behavior and lifestyles to coincide with the principles of sustainable development. In this respect, building environmental literacy through school curriculum has a very important role of positively changing human behavior towards the environment and its relationship with human beings.

While the school acknowledges the fact that such EE should be made available to all generations, education targeted at the young generation is undoubtedly the most important and the most effective. To achieve this, school curricula are expected to incorporate cross cutting themes such as water, energy, health, agriculture, forest; land management, ecosystem,

aquaculture, atmosphere, ecotourism, biodiversity, waste management, poverty, famine, family planning, environmental protection and conservation etc at various levels of schooling as they have paramount impact on students environmental attitude and behavioral action and making ultimately environmentally friendly citizens.

Environmental literacy is the cognitive and affective understanding of the environment that leads individuals toward environmental responsible behaviors, or actions directed toward the remediation of environmental problems.

Studies suggest that students who are exposed to environmental literacy develop: an increased caring about the future of society, an increased belief that they can make a difference and, an increased willingness to participate in civic engagement and help solve societal and environmental problems (Rowe, 2002). This means that "environmentally literate" students will have the knowledge, tools, and sensitivity to properly address an environmental problem in their professional capacity, and to routinely include the environment as one of the considerations in their work and daily living.

Furthermore; it is when an individual is environmentally literate (acquire knowledge of issues, develop sense of concern, sensitivity, skills and act accordingly) that he or she, for instance, accomplishes activities like proper disposal of wastes instead of dumping in to the environment, use electricity instead of fossil fuels, plant and care a tree for every cut, protect parks and wild lives instead of firing and hunting, consume recyclable materials, use public bus instead of individual cars, use water and energy wisely instead of being unwise, etc provided that accesses, opportunities and commitments there.

Measures ensuring that citizens are literate or illiterate about the causes and consequences of environmental damage are a necessary component of any strategy to resolve these problems. If people understand the critical issues on a personal level, they may be more willing to support the protection of environmental quality, biodiversity, and natural ecosystems.

In light of this, the purpose of this study was to analyze the levels of undergraduate regular students' environmental literacy- knowledge, attitude and behavioral practice. toward sustainable development and draw implications using Environmental Literacy Framework model.

In attempting to predict the magnitude of environmental literacy index and its components, the following basic questions were set.

1. What sources of information contributed to what they know about environmental issues and problems?
2. How low or high are undergraduate University students' environmental knowledge, attitude and practice against MOE/GEQAEA grading scales?
3. What is the extent of the relationship of an individual's score on the separate components of the environmental literacy survey (knowledge/cognitive, attitude/affective and practice/behavior)?
4. Will there be a significant difference in subpopulations (male/female, rural/urban, class standing, age, and natural science/social science) scores on the three components and the total score?

### *1.3. Significance of the study*

The findings of this study are expected to be a good input and source for the following pertinent bodies.

**Universities** - to plan an environmental literacy program and to design the program course across curricula to build environmental literacy for all graduates.

**Teachers**- to assess themselves and reorganize to be environmentally literate so that they will have the opportunity to transfer their skills to the wider school community by conducting

environment based education as they are the main agents or catalysts in an educational institution.

**Curriculum developers-** to incorporate environmental issues during reviewing curriculum materials, produce some guidelines and reorienting the education system at all levels.

**Environmental protection authorities-**to organize and facilitate stakeholders toward environmentally friendly behaviors and undertake environmental based adult education.

**Environmental actors (NGOs)-**to include EE in their package activities and catalyze public involvement in environmental programmes

**Researchers -** to conduct further in-depth research at institutional, regional and / or national levels.

#### *1.4. Delimitation of the study*

Taking in to account constrains of resource, the study is delimited to:-

**Setting** – faculty of education, at Bahir Dar University ,was the study site

**Conclusions-**the generalizations made are bounded to the survey study, and the participants of the faculty under consideration.

#### *1.5. Limitations of the study*

The investigator of this study doesn't believe that the study is totally free from any sort of limitations. As a result; the following constraints may affect the results of the study.

**Measuring instruments-**the instruments to measure participants' environmental knowledge, attitude and practice are either partly or wholly adopted, modified foreign standard scales and constructed as there are no locally available standard scales produced in line with the socio-economic and demographic context of Ethiopia.

**Methodology**-as a survey research, the study will not strictly examine the specific contents of environmental literacy rather it attempts to discover the overall picture.

**Test administration**- data were collected on one shot basis (only one time observation).

### 1.6. Operational definition of terms

**Environmental Problem** - a description of a known process within the environment or a state of the environment which has adverse effects on the sustainability of the environment including society

**Awareness** - is simple familiarity with an environmental subject with little real understanding of its deeper causes and implications such as water and air pollution, energy efficiency, solid waste, habitat loss, and climate change

**Environmental knowledge** – any real understanding formed through social interaction, personal experience, school attendance and observation in the context of time and space about environment (balance of nature, cause, effect) and human relationship

**Environmental attitude** - a learned belief (concern, fleeing, sensitivity, or perception) which develops from an individual's knowledge and values about the environment and governs action to support or sustain the environment.

**Environmental intention**-one's willingness to involve in various environmental activities and actions

**Environmental behavior** – the mental makeup that is instrumental to the practical action that one undertakes toward the conservation and protection of the environment

**Sustainability** - refers to the balance between the rate at which a particular system is depleted and the rate at which it replenishes itself

**Land degradation** - the decline in condition or quality of the land as a consequence of misuse or overuse, involving changes to soil, flora, fauna, water quality and quantity, visual quality and production levels by humans.

### 1.7. Organization of the paper

The project is divided into five chapters. In chapter one an overview and orientation of the study was given. The problem statement, research questions, and scope were demarcated. Concepts were also clarified to enhance understanding.

Chapter two concentrated on the literature review to establish what other theorists say about environmental issues, environmental education and environmental literacy in general.

In chapter three the design of the research instrument was discussed. The structured questionnaire consisting of 45 items and some respondents' background and academic information were discussed.

An analysis, interpretation and discussion of results of some of the empirical data were undertaken in chapter four.

Finally, important findings, conclusions and implications for further research were elucidated in chapter five.

## *Chapter- Two: Review of Related Literature*

In consideration of guiding research questions, the review (1) tries to highlight what mean by environment, environmental problems and environmental education as an introduction; and (2) discuss arguments on environmental literacy, its components, contributing factors, importance, barriers and some behavioral models applicable to environmental literacy as a major theme.

### **2.1. Over view of Environment, Environmental Problems and EE**

#### *2.1.1. The Environment*

The environment is our physical surroundings. This includes man-made, social and physical (natural) features. Human features include housing, transport and industry. Social features include things such as culture, language and political systems. Natural features include soil, the atmosphere, vegetation and wildlife. These three components have ongoing interactions, interconnections, and feedback mechanisms that determine the overall health and sustainability of each component.

#### *2. 1.2. Over view of Environmental Problems*

Throughout history humans have both affected, and been affected by the natural world (Ponting, 1991). But what has being changed right after the industrial revolution is the magnitude of the effects imposed on the environment that resulted from over production and resource consumption in a global proportion.

In his writing "*In Something New under the Sun*", McNeill (2000) indicates that "humans have impacted our planet more deeply in the twentieth century than we did in all previous history combined." Indeed, environmental problems now run rampant across the globe. The more serious issues include: ozone deterioration; deforestation; global warming; suburban sprawl and other human developments that disrupt ecosystems; urban air pollution; soil erosion; and species extinction.

The scientific community generally agrees that this effect may significantly alter the rainfall and temperature patterns worldwide during the 21st century. Natural variations in climate already have enormous impact on our lives, so the prospect that human activities might trigger undesirable changes in climate has led to widespread agreement that we urgently need to improve our capability to understand the Earth's system and predict climate so as to inform the public and policy makers at large (Brown,1990).

It is evident that while consequences of '*over consumerism lifestyles*' are the most serious cause of environmental damage in industrialized nation, *poverty* is a major cause of environmental damage in the Third World due to population increase, corrupt and inefficient governments and mainly the unjust way the global economy functions and the inappropriate approach to development the rich countries have promoted (Brown and et al, 2001). The living standard gap between the rich and the poor countries led not only into debt but also obliged poor nations to sell even more logs and coffee to pay their debts as well as led them to use much of the land for export cropping and have therefore forced many poor people to clear forests and to overgraze poor lands in order to grow food for them.

Especially destruction of forests and the loss of species result in famines, floods, erosion and droughts to occur each year. That is why there are now millions of "environmental refugees"; people fleeing because their environments have become unable to support them in developing countries (Ibid).

The following is highlight of some of the environmental problems that have resulted from human activity and over consumption and suggested remedial strategies.

1. **Global warming** - is a natural or human caused increase in the average temperature of the atmosphere near earth's surface worldwide. It is caused by release of green house gases like carbon dioxide, methane, water vapors, nitrous oxide, chlorofluorocarbons', and ozone. The greenhouse gases are mainly caused by human activity, especially exhaust emissions from internal combustion engines, coal-burning, electric power generators, and innumerable other

industrial processes. While rapid changes in global temperature, extreme weather patterns, super-storms, ecosystem impacts, rising sea levels due to the melting of the ice caps, failing agricultural output; increase in world hunger etc are its socio-economic consequences, implementing Kyoto protocol which demands reduction of emission gases and use of energy efficient technology are hoped to be the remedial actions. Probably the most undesirable effects will be hotter and drier climates in many Third World regions such as the African Sahel, where millions of people even now have difficulty growing enough food, and more frequent occurrence of extreme climatic events such as storms, floods, droughts and cyclones (Oskamp ,2000, 2001 and Brown ,2001).

**2. Ozone layer depletion** –loss of the earth's protective ozone layer due to the release of chlorofluorocarbons which accelerates ultraviolet radiation penetration. The main effects of ozone layer depletion are an increase in the incidence of skin cancer; eye disease; a reduction in the numbers of phytoplankton (photosynthesizing organisms in the sea that both, (a) absorb carbon dioxide from the atmosphere, and (b) form the base of the marine food chain); crop yields would suffer exposure to high concentrations of ultraviolet radiation; and material degradation like plastics (Oskamp ,2000, 2001 and Brown ,2001).

**3. Acid rain also known as acid precipitation-** is commonly used to mean the deposition of acidic components in rain, snow, dew, or dry particles. It is caused by oxides of carbon, sulfur and nitrogen which are by products of industrial wastes, roasting and combustion. The environmental effect of acid rain are lowering productivity in fisheries, forestry, and agriculture , accelerating corrosion, fracturing, and discoloration of buildings, structures, and monuments (Sandra,1984).

**4. Deforestation-** destruction of forests for the purpose of farmland, animal rearing, fuel or construction. Its effects include global climate change, loss of biodiversity or species due to destruction of tropical and temperate rain forests, intensifying desertification, famines, floods, erosion, droughts, environmental refugees and soil acidity. The expansion of human activity is destroying habitats and causing the extinction of plant and animal species at an accelerating rate. This is probably the most serious of all ecological problems. Some biologists estimate

that we are now losing 17,500 species every year, about 2 every hour (Wilson and et al, 1991).

5. **Pollution (air, water, soil)** - undesirable change in the physical, chemical and biological characteristics of air, water, soil that can adversely affect the health and survival of human and other living things. The main contributing agents are industrial wastes; incomplete combustion, heavy metals, commercial fertilizers etc. health risks and declining productivity are two of the socio-economic effects (Oskamp, 2000, 2001 and Brown, 2001).

6. **Population explosion** -rapid population growth affect environment through:

- Increase pressure on marginal lands, over exploitation of soils, overgrazing, overcutting of wood, soil erosion, flooding
- Increase use of pesticides, fertilizer, water for irrigation increase sanitation, pollution of fisheries
- Migration to overcrowd slums, problems of water supply and sanitation, industrial waste dangers, indoor and outdoor air pollution (Mersi 1990) cited in Kassahun (2006)

7. **Poverty** – poverty affect environment through:

- Difficulty in meeting today's needs means that short-term exploitation of the environment must take priority over long-term protection
- Lack of knowledge about environmental issues and long term consequences of today's action (UNICEF 1991) cited in Kassahun (2006).

### *2.1.3. Evolution of Environmental Education in Response to Environmental Problems*

The history of the development of the main terms and definitions of EE has been studied by different authors. According to Disinger (1983) the term "EE" appeared for the first time in 1948 at the meeting of the International Union for the Conservation of Nature and Natural Resources.

Gough (1997), Palmer (1997, 1998), and Sterling and Cooper (1992) date the appearance of the definition of EE to the end of the 1960s when this term began to be used and discussed on the international level.

#### 2.1.3.1. What is Environmental Education (EE)?

In a sense, all education is EE. In practical reality, EE focuses on the day to day interactions between whole organisms, their internal environments and the biophysical environments that surround them. One of the most widely accepted definitions of EE was given in the Tbilisi Declaration which was developed at the international conference of environmental educators, sponsored by UNESCO. There, EE is a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, Tbilisi Declaration, 1978).

According to the Declaration, EE is seen as a life-long process that is interdisciplinary and holistic in nature and application. It concerns the interrelationship between human and natural systems and encourages the development of an environmental ethic, awareness, understanding of environmental problems, and development of critical thinking and problem-solving skills.

Palmer and Neal (1994) as well as Rao and Reddy (2005) define EE as: 1) education *about* the environment which builds awareness, understanding and the skills necessary to obtain this understanding; 2) education *in* (or from) the environment, where learning occurs in nature, outside of the classroom; and 3) education *for* the environment, which has as its goals in nature conservation and sustainable development.

According to Stapp *et al.* (1969, p. 30), EE is a process aimed to produce "a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution."

Palmer (1997, 1998) gives another definition of EE that slightly differs from the definition given above. She defines EE as "the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture and his biophysical surroundings" (Palmer 1998, p. 27).

Like Stapp *et al.* (1969), Palmer stresses the importance of interconnections between man, his culture and nature. In addition, EE should also include practice in decision-making processes, the development of self-cognition, the formation of environmental ethics and environmental behavior, and the development of skills for environmental assessment. Palmer concludes that the special feature of EE is that the knowledge of environmental laws and principles of functioning of the natural systems are studied *within* the environment which helps to develop practical skills and the ability to make an assessment of the state of the environment.

An analysis of the works of Bergeson *et al* (2000), Klimov and Ukolov (1994), Palmer (1997,1998), Stapp *et al.* (1969), Sterling and Cooper (1992), Volk and McBeth (1998) by Bartosh (2003) reveals that the goals, objectives, principles and content of EE have been clearly defined in many regional and international studies and official documents. The main approaches identified in the works mentioned above are in consensus that the objective of EE is to develop the system of scientific knowledge and a positive attitude towards the environment, to form an understanding of the necessity of nature protection, to increase awareness of the problems in this field as well as possible solutions, and to form a positive attitude towards the environmental laws of society. Although this set of principles is discussed by many researchers, it should be stated that all of them use Recommendation 2 of the Tbilisi Intergovernmental Conference, 1977 as a basis (UNESCO, 1978).

According to MacGregor (2003), leading environmental educators such as Stapp and Hungerford emphasized that the field of EE differs from outdoor, nature and conservation education because it focuses on environmental *problems* and aims to find solutions to them. If so, then EE should help to develop patterns of responsible behavior as well as awareness,

skills, knowledge and attitudes necessary to act on behalf of the environment. Stapp *et al.* (1969) believe that "citizens should realize that the responsibility for the solutions to [environmental problems] belongs to them and to the governments which represent them" (p. 31).

Hungerford *et al.* (1980a) see the main aim of EE "... to aid citizens in becoming environmentally knowledgeable and above all, skilled and dedicated citizens who are willing to work, individually and collectively, towards achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment" (p. 43). The authors believe that it should provide learners with ecological knowledge, develop conceptual awareness and environmental action skills, as well as skills for investigation and evaluation.

In general, from the above theoretical discussions including UNCED (Agenda 21, chapter 36; 1992) the objectives and proposed models of EE in relation to promoting sustainable development comprise the following explicit issues.

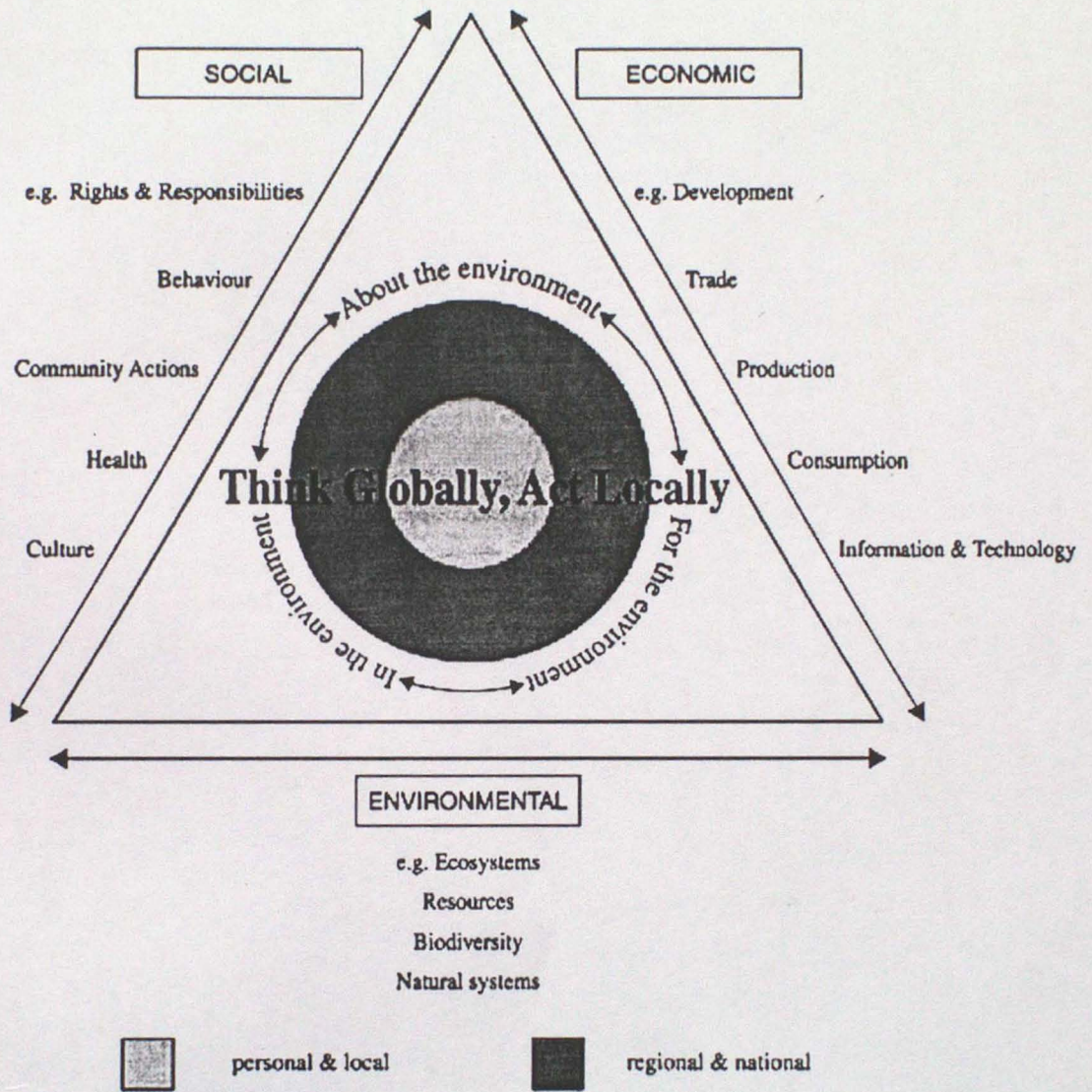
### **Objectives of EE**

- **Participation** - to provide individuals, groups and societies with opportunities to be actively involved in exercising their skills of environmental citizenship and be actively involved at all levels in working towards sustainable development.
- **Knowledge** - to help individuals, groups and societies gain a variety of experiences in, and a basic understanding of, the knowledge and action competencies required for sustainable development
- **Values** - to help individuals, groups and societies acquire feelings of concern for issues of sustainability as well as a set of values upon which they can make judgments about appropriate ways of acting individually and with others to promote sustainable development
- **Skills** - to help individuals, groups and societies acquire the action competence or skills of environmental citizenship - in order to be able to identify and anticipate

environmental problems and work with others to resolve, minimize and prevent them

- **Awareness** - to create an overall understanding of the impacts and effects of behaviors and lifestyles - on both the local and global environments, and on the short-term and long-term.
- **Evaluation ability:** to help individuals and social groups evaluate environmental measures and education programmes in terms of ecological, political, economic, social, aesthetic and educational factors (UNESCO-UNEP 1994).

### A Proposed Model for Environmental Education Towards Sustainable Development



Source- [www: unesco.org](http://www.unesco.org) accessed on May,2007

## 2.2. Environmental Literacy and Behavioral Theories

### 2.2.1. Environmental literacy (EL)

In its earliest uses, the term literacy referred solely to the ability to read and write; one either could or could not. In point of fact, the term "illiterate" predated the positive term with respect to general literacy, as literacy includes: mathematical literacy, computer literacy, visual literacy, cultural literacy, and so on. As described by Michaels and O'Connor (1990):

*Literacy...is an inherently plural notion. We each have, and indeed fail to have, many different literacies. Each of these literacies is an integration of ways of thinking, talking, interacting, and valuing, in addition to reading and writing...Literacy then is less about reading and writing per se, and is rather about ways of being in the world and ways of making meaning with and around text*

Environmental literacy is a difficult concept to define. Orr (1992), environmental educator, poses the multiplicity of questions that the quest for environmental literacy brings in his book *Ecological Literacy*:

*"The crisis of sustainability and the problems of education are in large measure a crisis of knowledge. But is the problem as is commonly believed, that we do not know enough? Or that we know too much? Or that we do not enough about some things and too much about other things? Or is it that our scientific methods are in some ways flawed? Is it that we have forgotten things we need to remember? Or is it that we have forgotten other ways of knowing that lie in the realm of vision, intuition, revelation, empathy, or even common sense? Such questions are not asked often enough....." (Orr, 1992, pp. 155)*

David Orr cites Garrett Hardin's (1968) definition of ecological literacy as "the ability to ask 'What then?'," and goes on to say that in addition to the ability to read and calculate (literacy and numeracy--both indoor activities of education), ecological literacy also implies an intimate knowledge of our landscapes, and an affinity for the living world. It is, too, a systemic view, "to see things in their wholeness" (Orr, 1992). This approach means that we

cannot simplify or abstract problems to a level where their connections to the context are lost. The analytical modes of teaching we often use, especially in science courses, often abstract problems from the context in the perceived interest of clarity and simplicity. But this clarity is deceptive, because, devoid of context--and hence apparent relevance--the ideas do not stay with the students.

Stephen Schneider (1997), climatologist, and educator, states that it is "an unattainable goal to expect students to gain a detailed knowledge about the content of all environmentally relevant disciplines." Instead, he proposes that students should be taught how to ask three questions to the experts that include "what can happen," "what are the odds," and "how do you know." He argues that students do not need to know the technical aspects of opposing views, but they should have the skill to evaluate the credibility of the process.

In a survey of environmental literacy at colleges and universities, in USA, environmental literacy was defined as "a basic understanding of the concepts and knowledge of the issues and information relevant to the health and sustainability of the environment as well as environmental issues related to human health" (Rowe, 2002).

In Scotland, curriculum planners have included environmental literacy as one of the four goals of "environmental citizenship" (Scottish Office, 1993), defining it in terms of "knowledge and understanding of the components of the system" (p.4).

While each of these definitions of environmental literacy might have its practical uses, none is overtly grounded in the primary academic debate about the nature of literacy.

Most literacies are defined in cognitive terms. Knowledge is a necessary pre-condition of thoughtful behavior and action. Educational systems usually limit their operational objectives to the attainment of knowledge and skills related to their effective and efficient acquisition; they do not actively promote the pro-active development of "responsible environmental behavior," as described by Hungerford (1987). Individual and societal environmental

behavior, however, belies the assumption that behavioral change follows directly from development of necessary knowledge and skills (Iozzi, 1989).

Since the term was coined, a distinguishing characteristic of environmental literacy has been its "action" perspective. That is, environmental literacy is about practices, activities, and feelings grounded in familiarity and sound knowledge. Just as reading becomes second nature to those who are literate, interpreting and acting for the environment ideally would become second nature to the environmentally literate citizen. The idea of literacy is taken a step farther, intending not only an "understanding of the language of the environment, but also its grammar, literature, and rhetoric." (Amanda 2001). It involves understanding the underlying scientific and technological principles, societal and institutional value systems, and the spiritual, aesthetic, ethical and emotional responses that the environment invokes in all of us.

As part of the American work on "standards", Roth (1992) provides a framework for environmental literacy in relation to knowledge, affect, skills and behavior at three levels of competence (nominal, functional and operational).

1. *Nominal level*- indicates the ability to recognize many of the basic terms used in communicating about the environment and to provide rough, if unsophisticated, working definitions of their meanings;

2. *Functional level*- indicates a broader knowledge and understanding of the nature and interactions between human social systems and other natural systems; and

3. *Operational level*- indicates the progress beyond functional literacy in both the breadth and depth of understandings and skills.

#### *2.2.1.1. What are the attributes of the environmentally literate?*

On the extending the above, Roth (1992) specifies that persons at the operational level routinely evaluate the impacts and consequences of actions, gathering and synthesizing pertinent information, choosing among alternatives, advocating action positions, and taking

actions that work to sustain or enhance a healthy environment. Such people demonstrate a strong, ongoing sense of investment in and responsibility for preventing or remediating environmental degradation both personally and collectively, and are likely to be acting at several levels from local to global in so doing. The characteristic habits of mind of the environmentally literate are well ingrained. They are routinely engaged in dealing with the world at large.

For educators such as Simmons (1989) a complication is the interdisciplinary nature of environmental literacy and he apparently assumes that environmental literacy is equivalent to, or a subset of scientific literacy. There is good reason for making this assumption: "...environmental education has not been infused equally within the curriculum, but tends to be treated mostly as an enrichment of the science program." However; the danger Roth (1992) argues is that scientific literacy appears to be built on a mechanistic paradigm, whereas environmental literacy builds on an ecological paradigm. More importantly, environmental literacy derives its focus from four basic issues that take it well beyond the typical boundaries of science education, or any of the traditional disciplines:

*The interrelationships between natural and social systems; the unity of humankind with nature; technology and the making of choices; and developmental learning throughout the human life cycle (ibid).*

Thus, environmental literacy draws upon six major areas: environmental sensitivity, knowledge, skills, attitudes and values, personal investment and responsibility, and active involvement. In Roth's (1992) descriptions of the specifics of literacy level, environmental sensitivity and attitudes and values are subsumed under the term "affects," while personal investment and responsibility and active involvement are subsumed under the term "behavior." This creates four strands--knowledge, skills, affect, and behavior--to be addressed in education for environmental literacy.

### **2.2.1.1.1. Functional, cultural and critical environmental literacies**

#### **Functional environment literacy**

Functional print literacy can be measured by objective tests, which can be purely summative, or may be diagnostic if subjected to miscue analysis, which analyses reader's errors. Functional literacy is not just a matter of knowing what words mean, but of being able to find out what they mean in the context of whole sentences by the use of phonic and contextual cues.

Functional environmental literacy must, therefore, refer not only to the ability to remember what an oak tree is, but also to recognize one; not only to recognize several trees within a given area, but also to know whether they form part of a wood or an area of parkland.

Functional literacy involves a series of complex skills and an accumulation of knowledge which has unlimited capacity for growth. Arguably, much science education in schools focuses chiefly on what is defined here as functional literacy, whether or not this entirely reflects intentions. Certainly, its role in environmental education should not be underestimated (Williams and Snipper, 1990).

#### **Cultural environmental literacy**

Cultural literacy refers to the ability to understand the significance that society attaches to cultural icons. Such icons include, of course, living natural objects and national parks.

While functional environmental literacy develops knowledge of what natural things are, cultural environmental literacy enables us to explain why they are there when the causes are clearly not simply geological or climatic with no apparent human intervention.

Cultural literacy depends on a degree of acceptance of cultural hegemony: it links the learner with a dominant value system. Cultural literacy refers more to cultural heritage than to cultural analysis. Insofar as cultural literacy is empowering, it empowers by giving the learner

access to socially powerful perspectives; cultural literacy alone does not enable the learner to act upon that knowledge, once acquired. Effective action requires critical literacy (Hirsch, 1987, Marum, 1996).

### **Critical environmental literacy**

Critical literacy is the ability to understand the text on a deeper and more creative level: the ability to discuss the use of genre in context, to question the motives and ideology of the text, and to explore and develop personal (and broader social) response to it. Critical environmental literacy must then imply the power to develop an understanding of the factors that contribute to environmental change and to have a view on how to further to oppose that change in a way which can be translated into action. Critical environmental literacy involves the ability to explore questions such as: what does [a place or an issue] mean to me?, what does it mean to us, or to others? , what are the consequences of carrying on in this way [in relation to this place or this issue]?, should we act differently, and if so how?, how do we translate our values into effective action - and are our values themselves ready for change as a result of what we now know or feel? (Habermas 1987).

As has been stressed above, critical literacy cannot be effectively developed without good levels of both functional and cultural literacy, though the latter are arguably pointless without the former. Critical environmental literacy relies on functional environmental literacy because both environmental debate and environmental action rely on information. Critical environmental literacy relies on cultural literacy not simply because environmental debate and action need to be grounded in an awareness of the norms and values of, say, national cultures, but because influence on environmental change demands an understanding of the norms and values of the dominant culture.

In general; environmental literacy should be perceived as a developmental process rather than an end state; it is a continuum of understandings, skills, attitudes and habits of mind.

### 2.2.1.2. Importance of Environmental Literacy

The term "environmental literacy" (EL) is used to describe an individual's capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore or improve the health of those systems.

Roth (1968) asserts that an individual who is environmentally literate would have: (1) knowledge of relevant environmental concepts, problems and issues; (2) concern for the quality of the environment; (3) knowledge of action strategies that may be used for resolving an issue; (4) belief that their action can make a difference; (5) commitment to take action; and (6) experience in action based activities.

Several recent studies performed as part of the Masters' program in the School of Education identified several common conditions that exist among those considered environmentally literate and includes:

*Frequency of interaction with nature (outdoors); significant role model, generally and most frequently an educator and then a parent; knowledge and the practice of community service on behalf of the environment (O'Neil, 2006).*

Thus, environmental literacy demands understandings, skills, attitudes, and habits of mind that empower individuals to relate to their environments in a positive fashion, and to take day-to-day and long-term actions to maintain or restore sustainable relationships with other people and the environment.

### 2.2.3 Barriers for building Environmental Literacy

EL is the desired outcome of environmental education (EE) programmes. Environmental literacy requires a fundamental understanding of the systems of the natural world, the relationships between the living and the non-living environment, and the ability to deal sensibly with problems that involve scientific evidence, uncertainty, and economic, aesthetic and ethical considerations. Although many states require EE to be taught in all grades and

subjects, EE has not become an integral part of school curricula. Teachers and EE professionals name various reasons for the lack of environmental education in their classrooms. Lack of time, money and training, lack of support and other curriculum pressures are only some of them (Pennock and Bardwell 1994).

#### **2.2.4. Components of Environmental literacy**

##### **2.2.4.1. Environmental knowledge**

The knowledge and understanding of a range of concepts and connections are required in order for an interested person to think and make decisions coherently about individual and societal behaviors that affect the environment. To be knowledgeable about the environment, citizens and pupils should *know and understand*: 1/ the physical processes that shape the patterns of the Earth's surface; 2/ the characteristics and spatial distribution of ecosystems on Earth's surface; 3/ the characteristics, distribution, and migration of human populations on Earth; 4/ the patterns and networks of economic, social, and political interdependence on Earth; 5/ the processes, patterns, and functions of human settlement; 6/ how human actions modify the physical environment; 7/ how physical systems affect human systems; 8/ the changes that occur in the perception, use, distribution, and importance of resources; 9/ the cause and effect relationship between human attitudes and behavior and the environment; 10/ how to evaluate alternative responses to environmental issues before deciding on alternative courses of action; and 11/ the effects of multiple uses of the environment (Roth, 1991).

Lieberman and et al (1997) also summarize that:

*The Earth is a set of interacting natural and social systems, and an environmentally literate person must understand the relationship of the parts of a system and the interdependence of human and environmental systems as the content of environmental education is the exploration of the relationships between social and natural system.*

#### 2.2.4.2. Environmental Attitude

The extraction and removal of environmental resources in the world today is being performed in such a way and to such an extent that the environment is not able to restore the damage that is being done. The industrial practices of today are advantageous in that they result in higher living standards and more convenient ways to do everyday activities, but the environmental impacts that result are accepted as a reasonable side effect (Kaiser et al, 2003). It is mankind's responsibility to acknowledge these problems and do their part to protect the environment they live in.

According to Fishbein and Ajzen (1975), attitude is a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object. When we think about attitudes toward environmental issues, we often assume that these attitudes fall along a continuum from low (not concerned) to high (very concerned). These attitudes might reflect general concern for environmental issues, or attitudes about specific issues like recycling, energy conservation, or public transportation. However, research suggests that there are different types of attitudes, and that two people can be equally concerned about environmental problems, but for very different reasons.

For instance; a research examining the different types of environmental attitudes, by Schultz (2002) in different country College students (United States, Mexico, Nicaragua, Peru, and Spain), using the essay question "The environmental problems that concern you the most, and why", revealed that many of the respondents indicated that their greatest concern was pollution. Among these, some respondents indicated that their concern was based on the fact that air pollution has been shown to cause cancer, and they (the individuals) didn't want to breathe polluted air. Another set of respondents indicated that polluted air will increase the rate of sickness in people around the world and reduce the quality of life for everyone.

Finally, a third group of respondents indicated that pollution is killing plants and animals and threatens to disrupt the balance of nature.

Each of these sets of concerns reflects different underlying values which are referred either as egoistic, altruistic, or biospheric attitudes (Schultz et al, 2000) where:

*Egoistic* concerns are focused on the individual, and reflect a concern about environmental problems for self. These concerns include personal health, financial well-being, quality of life, and availability of resources.

*Altruistic* concerns focus on people other than self, including friends, family, community, future generations, or humanity and finally

*Biospheric* concerns focus on all living things, including plants, animals, ecosystems, and the biosphere.

Environmental attitude of young people appears to be crucial as they ultimately play a direct role in providing knowledge-based solutions to in-coming environmental problems (Bradly et al., 1999; Eagles and Demare, 1999). Furthermore, school environmental program, although addressed to students, can also influence the environmental knowledge, attitude and behavior of adults (parents, teachers and local community members) through the process of Intergenerational influence (Evans et al., 1996; Ballantyne, 1998; Gallagher et al., 2000).

#### **2.2.4.3. Environmental Responsible Behavior**

EL requires more than a mastery of subject matter; ultimately, it is a way of thinking, experiencing and acting. Data indicate that a good knowledge of environmental concepts is not sufficient; knowledge of environmental issues, issue skill analysis, and attitudes and values related to taking action are also necessary for the individual to take action and to act responsibly (Engelson, 1985).

According to Hines and et al (1986/87) and Hungerford and Volk (1990) *environmentally responsible behavior* [for instance recycling as personal choice or political activism] is gradually developed by 1) *entry level* variables, including the ability to experience and enjoy nature (*environmental sensitivity*) and knowledge of ecology; 2) *ownership* variables, such as

in-depth knowledge and a personal investment in the environment; and 3) *empowerment* variables like internal locus of control and intention and ability to act for the environment.

To improve environmental responsibility, environmental education should focus on the personal *locus of control*, which can be either external or internal (e.g. Hungerford & Volk, 1990; Stern, 1992; Fransson & Gärling, 1999). External locus of control refers to the belief that the power to cause changes in one's own personal life is outside the individual and that he or she cannot do anything to affect it. Internal locus of control is the belief that one's own actions make difference.

Hungerford and his associates have analyzed research on variables related to the development and demonstration of environmentally responsible behavior and have designed and tested a set of instructional materials in a research mode (Hungerford, 1985). The materials stress a hierarchical-approach involving four levels of activities (Hungerford cited in Disinger, 1987):

1. Ecological concepts; 2/ Conceptual awareness; 3/ Issue investigation and evaluation; 4/ Environmental action skills or training and application

Results of research data indicates that behavior change usually will not occur if students are exposed only to Goals 1 and 2. The data also indicates that behavior will change if students are thoroughly exposed to Goals 3 and 4 in addition to 1 and 2. The quality of the students' environmental actions also tends to improve when they have used issue analysis and investigation.

In general, a study in Taiwan by Hsu (2003) recommended that, an individual who developed an environmental responsible behavior will accomplish and / or demonstrate the following environmental behaviors.

### **Resource recovery and waste management**

- Use mugs instead of paper cups, cloth instead of paper napkins, rags instead of paper towels.
- Double-side photocopies; use reverse sides of paper.
- Bring your own canvas shopping bags to the market, or reuse the bags.
- Buy returnable/recyclable glass, metal, or plastic containers.
- Separate your recyclables (e.g., newspaper, glass, paper, aluminum, and clothing) from trashes that you cannot reuse and that is being sent to the landfills.
- Reduce purchasing items which are over packaged.
- Save cardboard boxes for later use.
- Return deposit beverage containers to stores.
- Maintain and repair appliances, tools, and other equipment to lengthen their lives.
- Share, barter, trade, or donate what you no longer need, but which has value to others.

### **Energy and water conservation**

- Switch off lights in any space when not in use.
- Use electricity and hot water efficiently.
- Set your air-conditioner control to a moderate temperature (about 28 centigrade degrees), and clean air-conditioner filter and coils regularly.
- Adjust the temperature of your refrigerator-freezer based on the quantity of contents stored.
- Purchase energy-efficient appliances, e.g., refrigerators, air conditioners, washing machines, and dryers.
- Do not let water run when it's not actively in use.
- Install sink faucet aerators and water-efficient shower-heads.
- Promptly replace rubber washers on leaky water valves.
- When washing dishes in the sink, plug and fill second sink with rinse water rather than running water freely.

- Buy non-toxic, phosphate-free, biodegradable soaps and detergents.

### **Transportation and air quality Control**

- Use public transportation, carpool, bike, or walk.
- Save gas by driving smoothly, within the speed limit; have regular tune-ups and emissions checks.
- Purchase an energy efficient car, e.g., renewable-energy automobiles.
- Encourage the development of electric cars.
- Support for taxing gasoline to encourage its more efficient use.
- Purchase the ozone-safe products, e.g., coolants for refrigeration, even though the costs of these products are higher.
- Eliminate smoking in public places, e.g., offices, factories, trains, and buses.
- Replace the cars that have old engines and exhaust systems.
- Use only unleaded gas.
- Plant and care for trees in your own property, community, and town.

### **Natural resource management**

- Reduce human population growth by limiting family size.
- Reduce consumption wherever possible.
- Don't buy endangered plants, animals, or products made from overexploited species, such as furs, ivory, reptile skin, and tortoise shell.
- Support consumption of locally produced goods and produce from local farmers.
- Buy products from companies that don't pollute or damage the environment and don't test products on animals.
- Understand the significance of cultural differences; and respect the nature and living diversity when touring in the cultural, historical, and/or protected areas.
- Avoid food whose production endangers wildlife and/or their habitats (e.g., high mountain vegetables and teas).

- Avoid buying wood from the tropical rainforests unless you are sure it was propagated by sustainable tree farming methods.
- Take part in local conservation research activities (e.g., field works, surveys, monitoring, etc.) to help establish a system for protecting natural habitats, ecosystems, and species in the area.
- Join, support, and volunteer your time to organizations working on issues of environmental conservation that are important to you.

### **Social/political actions**

- Talk to family, friends, and other students about what we can do to help solve environmental problems.
- Encourage others to become involved in some kind of behavior(s) toward environmental conservation (e.g., recycling or reusing resource materials, conserving water and energy, car-pooling, participating in community cleanup projects, etc.)
- Communicate with others about the significance of environmental protection.
- Report to the authorities in the cases where an individual or organization has been violating the environmental law (e.g., illegal hunting/fishing/wildlife collections, pollutant dumping).
- Participate in some type of educational program for the purposes of learning more about environmental matters.
- Vote for a “pro” environment candidate.
- Write to or call elected officials telling them to support environmental protection.
- Donate money to an organization or an environmental project in order to help in the resolution of the particular issue.
- Sign a petition in support of “pro” environmental policies and/or legislation .
- Attend a public meeting or political rally/speech on town or school affairs

## 2.2.5. Theoretical Behavioral Models

### 2.2.5.1. Major Theories Relevant to Environmental Literacy

Various disciplines ranging from psychology and sociology to marketing and advertising describe in excess of theories that mediate behavior. Invariably, these theories are based on knowledge, attitude, and behavior components. Thus, these models hypothesize how the components of environmental literacy- knowledge, attitude, and practice/behavior- interact. Since the purpose of this study is to examine the correlations between these components, it is necessary to be familiar with the theoretical basis of these relationships.

#### 2.2.5.1.1. Theory of planned Behavior (TPB)

Several approaches to understanding environmental concern and its relation to pro-environmental behavior have been developed. Perhaps the most frequently referenced model used to describe the correlative components is the **theory of planned behavior** (Ajzen 1985, 1988, 1991) that resulted from Ajzen and Fishbein's (1980) Theory of Reasoned Action (TRA) presented below in figure 2-1 and figure 2-2.

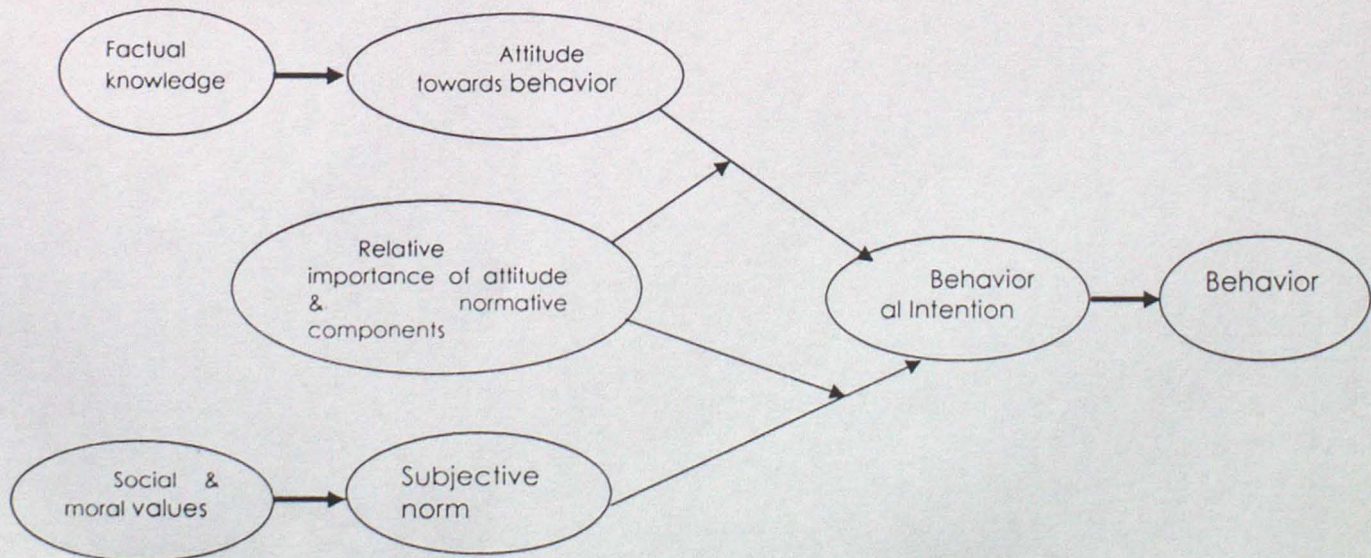


Figure 2-1. The Theory of Reasoned Action or TRA ( Ajzen and Fishbein,1980)

Knowledge is not a specific component in the model but Ajzen and Fishbein (1980, p.7) do state that, "attitudes are a function of beliefs," In this context, beliefs refer to knowledge about a specific behavior.

Dillon and Gayford (1997) further support the notion that Azjen's model does allow for representation of cognitive elements through affective by their influence on beliefs. For example; when a person understands that they have control over a certain situation, their behavioral intentions refer this.

Regarding the relationship of all the components of the Theory of Reasoned Action, Ajzen and Fishbein (1980, p.91) remark that:

*On the basis of different experiences, people may form different beliefs about the consequences of performing a behavior and different normative beliefs. These beliefs, in turn determine attitudes and subjective norms which then determine intention and the corresponding behavior. We can gain understanding of a behavior by tracing its determinants back to underlying beliefs, and we can influence the behavior by changing a sufficient number of these beliefs.*

Thus, knowledge or belief, have a mediated connection through attitudes, subjective norms and intention prior to behavior. The relative importance of the attitude and subjective norm in determining the intention will be different for each individual and situation.

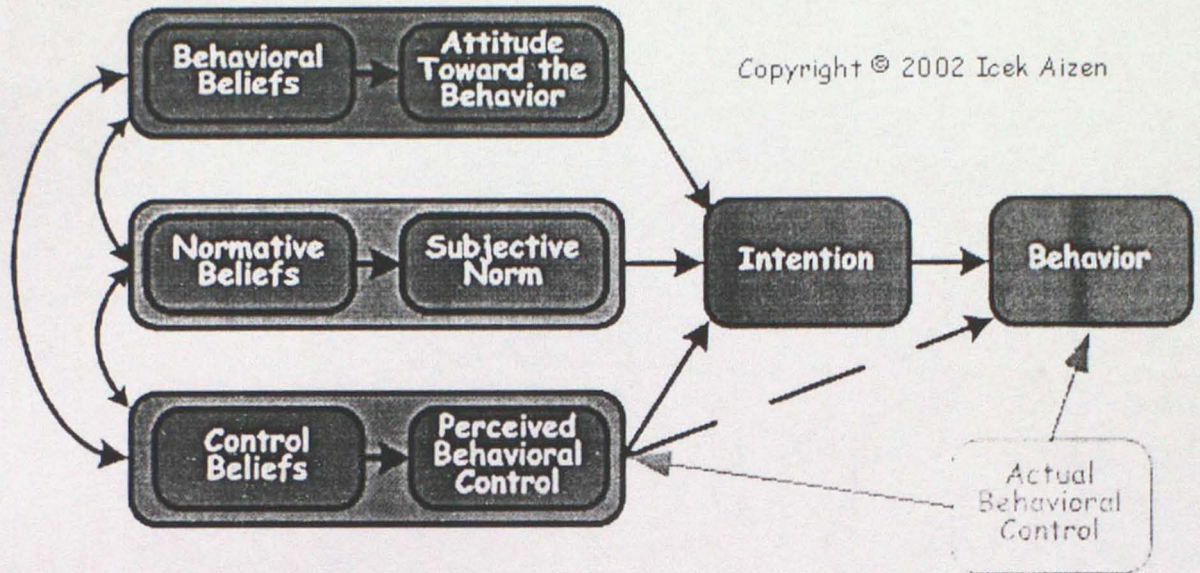


Figure 2-2. Theory of Planned Behavior (Ajzen, 1991)

The basis of the Theory of Planned Behavior (TPB) is that attitude, subjective norm, and perceived behavioral control all influence behavior through an intention component.

In the theory of reasoned action (Ajzen & Fishbein, 1980) and its developed version, the theory of planned behavior (Ajzen, 1991), behavior *intention* to perform the behavior in question is the immediate antecedent of overt behavior. Intention, in turn, is seen as a function of one's attitude towards performing a particular act and one's subjective norms i.e. the perception of the expectations of relevant others. Because attitude includes not just the evaluation of a certain outcome but also the estimation of the likelihood of this outcome, salient information or factual *knowledge* is a necessary precondition for any attitude (Stutzman & Green, 1982).

As subjective norms refer to the strength of normative beliefs and the motivation to act in accordance with these beliefs, social and moral *values* i.e. what one should do from a normative standpoint, social expectations as well as moral principles, can be considered as an approximation of one's subjective norms.

The major modification in the TPB from the TRA is the addition of a perceived behavioral control component, an independent link to the behavior that is not moderated by the behavioral intention component. Perceived behavioral control "refers to the perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles (Ajzen, 1988, p.132)." When an individual believes that they can influence the political process related to environmental policy, they are more likely to be involved in political action and lobbying. Another example is if an individual does not believe that when they put a can in to a recycling bin that it is actually recycled, they are not very likely to recycle their cans. Thus perceived behavioral control is a mediating factor of whether or not an individual, regardless of their attitude, will engage in responsible environmental behavior.

One could hypothesize that a person who has positive attitudes, subjective norms, and perceived behavioral control regarding a specific behavior will have a positive intention and a high likelihood of actually performing the behavior. Ajzen (1988) further points out that perceived behavioral control may have very practical constraints relating to situational conditions where as intention only refers to an individual's willingness to perform a behavior, hence the direct connection to the behavior. For example, if someone is very willing to use a solar water heater, but there are no solar water heaters to purchase or materials or knowledge to make one, then it is not possible to adopt the use of a solar water heater even if the individual is willing to do.

#### **2.2.5.1.2. Models of Environmental Responsible Behavior**

The term 'environmental responsible behavior' refers to "the variety of recognized approaches to environmental action available to individuals and groups to use in preventing or resolving environmental problems or issues" (Hsu and Roth, 1988, p.232).

Hines et al (1986/87) proposed the model of responsible environmental behavior which is shown in fig 2-3. In order to construct this model, the researcher performed a meta – analysis of 128 previously conducted environmental behavior prediction studies.

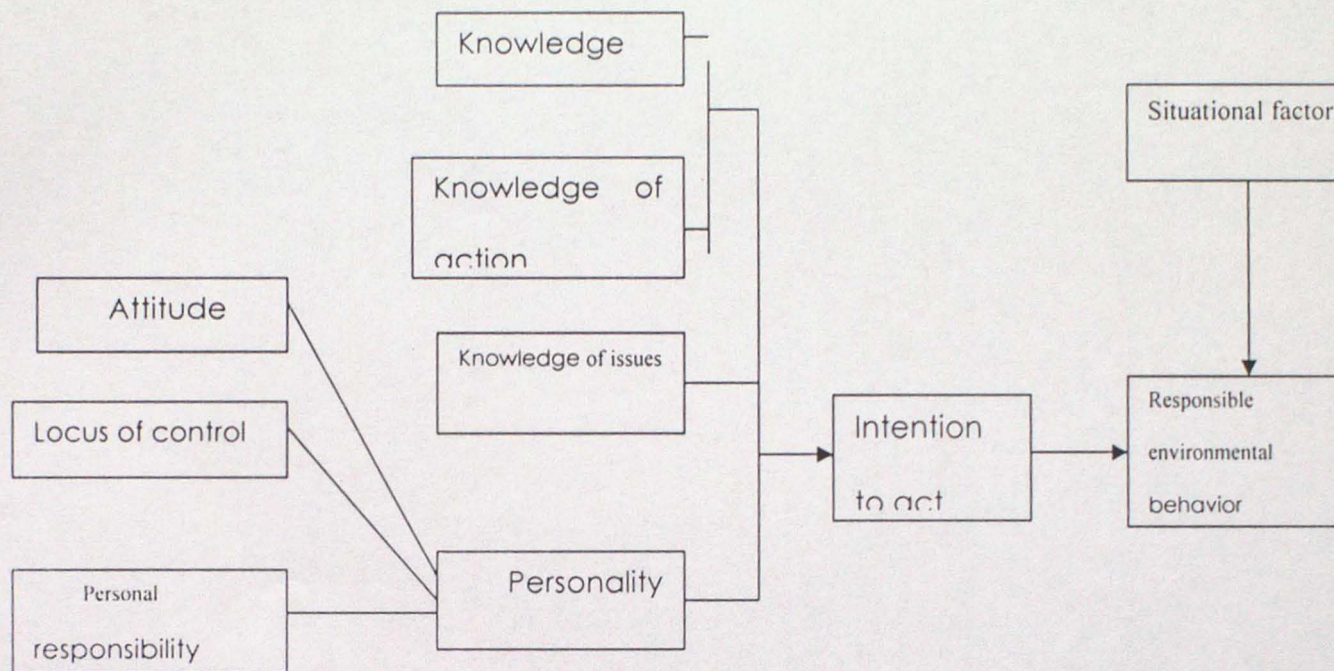


Fig 2-3 proposed responsible environmental model (Hines et al 1986/87)

Hines et al.'s model describes how the different types of knowledge interact to determine the intention to act, which then leads to the desired responsible environmental behavior.

Unlike the TPB, knowledge is one of the base components of the model proposed by Hines et al., but the researchers are careful to show that it is not simply factual knowledge that is the source of responsible environmental behavior." An individual must also possess knowledge of those courses of action which are available and which will be most effective in a given situation" (Hines et al. 1986/87, p.6). This is particularly important as situational factors create changeable conditions which need to be adapted accordingly. On the basis of their model, Hines et al. proposed that knowledge and skill components can and should be addressed by environmental educators.

In Hsu and Roth's (1998) study of environmental responsible behavior in secondary school teachers in Taiwan, they found that knowledge and skill in using environmental action

strategies were powerful predictors of responsible environmental behavior. Moreover; they suggest that these two predictors should receive major emphasis at secondary and post-secondary levels. Further, Hsu and Roth (1998,p240) comment, ' one may infer that an individual is more likely to express an intention to take environmental action if that individual has knowledge of environmental action strategies, accepts environmental responsibility (i.e sense of obligation toward alleviating environmental problems) and has positive environmental attitudes." Hines et al (1986/87) recognized that prediction of behaviors is very complex and further research is necessary to understand how all of the variables in the model relate to each other. They recommend that research focus on many components rather than just the interaction of two to components to start to achieve a more holistic picture of responsible environmental behavior.

### 2.2.5.1.3. Environmental Literacy Frame Work

Marcinowski and Rehring (1995) proposed the environmental literacy framework that was used in constructing the Environmental Literacy Survey (ELS), the instrument used as the basis for the study presented in this thesis. Major components of ELS are: 1) cognitive dimensions (knowledge and skills); 2) affective dimensions (attitude and self efficacy); 3) personal involvement in environmentally responsible behaviors (eco-management, economic/consumer action, etc).The modified environmental literacy framework that will be used to interpret the relations among environmental literacy components are presented in figure 2.4.

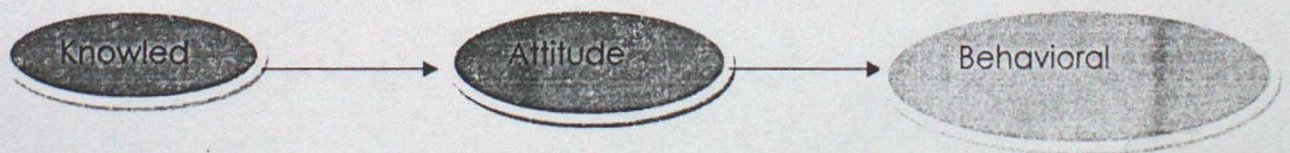


Figure 2.4.Modified environmental literacy framework

This model implies that behavioral intention which is the central element of both the Theory of Reasoned Action (Azjen and Fishbein,1980) and Theory of Planned Behavior (Azjen,

1988,1991) is included as part of the attitude section. This is primarily because behavioral intentions are measured from attitudes, subjective norms and, in some cases, from perceived behavioral control elements. "It appears that intention to act is merely an artifact of a number of other variables acting in combination (e.g cognitive knowledge, cognitive skills, and personality factors)" (Hines et al, 1986/87, p.6)

This modified environmental literacy framework was designed, as a result of the work of Marcinowski and Rehring (1995) to allow universities to track progress on the components that universities can impact – knowledge and attitudes – in creating environmentally responsible students.

#### **2.2.6. Knowledge, Attitude and Practice Nexus**

Am I part of the natural environment, or am I separate and perhaps superior to nature? The answer to this question influences the types of attitudes that individuals within a given culture are likely to develop, the types of environmental behaviors that individuals are likely to adopt, and more generally, beliefs about how to solve environmental problems.

##### **Attitude effect**

If environmental attitude is assessed by one single measure regardless of the type of environmental attitude, the usual findings reveal either a moderate relationship between environmental attitude and environmental behavior (Hines *et al.*, 1986/87; Smith *et al.*, 1994) or a weak relationship (Moore *et al.*, 1994; Grob, 1995) cited in Kaiser et al, 1999).

However, at least five studies report no such relationship at all (Arbuthnot, 1977; Van der Pligt, 1985; Oskamp *et al.*, 1991; Lansana, 1992; Gamba & Oskamp; 1994 cited in Kaiser et al, 1999) and one study yields a strong association between environmental attitude and behavioral practice (Lynne & Rola, 1988). If environmental attitude refers to components, for instance, environmental knowledge, environmental values and environmental behavioral intention, the following findings are reported.

### Knowledge effect

Given that factual knowledge about the environment is a precondition of one's environmental attitude, this knowledge should not be related with ecological behavior strongly because its influence is attenuated both by environmental attitude and ecological behavior intention. Hence, it is not surprising that several studies found either no relationship between factual environmental knowledge and ecological behavior (Schahn & Holzer, 1990a, 1990b) or at best a moderate relationship (Hines *et al.*, 1986/87; Oskamp *et al.*, 1991) cited in Kaiser et al (1999).

When this relationship appears to be stronger, it is knowledge about ecological behavior i.e. knowledge about what and how something can be done rather than factual knowledge about the environment that is related to ecological behavior (Sia *et al.*, 1985/86; Smith-Sebasto & Fortner, 1994) cited in Kaiser et al (1999).

### Value effect

As proposed by the theory of planned behavior, one's subjective norms (Olsen, 1981; Kantola *et al.*, 1983; Midden & Ritsema, 1983) and normative beliefs regarding environment (McGuinness *et al.*, 1977; Stutzman & Green, 1982) affect his or her intention to behave ecologically. However, this effect ranges from rather weak (Midden & Ritsema, 1983) to fairly large (McGuinness *et al.*, 1977).

Furthermore, this relationship decreases if ecological behavior instead of ecological behavior intention is considered (Vining & Ebreo, 1992) presumably indicating the mediating effect of ecological behavior intention. One's environmental values parallel these findings: environmental values are related to ecological behavior intention (Dunlap & Van Liere, 1978; Van Liere & Dunlap, 1981; Axelrod, 1994) cited in Kaiser et al (1999) and if environmental values are related to ecological behavior (Verhallen & Van Raaij, 1981; Stern *et al.*, 1993; Grob, 1995) cited in Kaiser et al (1999) they are presumably mediated by a third variable. According to the theory of planned behavior, this mediator is ecological behavior intention.

### **Intention effect**

The most striking effect usually found is between ecological behavior intentions and ecological behavior. Ecological behavior intention is strongly related to ecological behavior (Schahn & Holzer, 1990a, 1990b; Lansana, 1992; Auhagen & Neuberger, 1994 cited in Kaiser et al, 1999) or at worst moderately related (Hines *et al.*, 1986/87; Moore *et al.*, 1994; Diekmann & Franzen, 1995 cited in Kaiser et al, 1999). Unfortunately, there are some types of ecological behavior with which no such relationship is found (Auhagen & Neuberger, 1994; Fuhrer & Wolfing, 1997 cited in Kaiser et al, 1999) and at least two studies in which the relationship between ecological behavior intention and ecological behavior appears to be small (McGuinness *et al.*, 1977; Van Liere & Dunlap, 1981).

### **Specific vs General behavior**

The possible lack of measurement correspondence between environmental attitude and ecological behavior is well recognized (Stern, 1992b; Vining & Ebreo, 1992; Axelrod & Lehman, 1993 cited in Kaiser et al, 1999) and it can be summarized as follows: if one's environmental attitude is assessed generally, 'the behavioral criterion should be equally general or comprehensive' (Weigel *et al.*, 1974: p. 728).

As specific measures appear to be affected more easily than general measures, general environmental attitude measures are proposed as better predictors of comprehensive ecological behavior criteria (Newhouse, 1990). Even though some data apparently confirm this notion by strong relationships between general environmental attitude and general ecological behavior measures (Lynne & Rola, 1988; Axelrod & Lehman, 1993 cited in Kaiser et al, 1999) others do not (Scott & Willits, 1994; Smith *et al.*, 1994; Grob, 1995 cited in Kaiser et al, 1999). These puzzling findings concerning the relationship between general environmental attitude and general ecological behavior may also be due to measurement problems related to general ecological behavior measures (Kaiser, 1998).

### Consideration of influences beyond people's control

As previously stated, the relationship between environmental attitude and ecological behavior may be affected by influences beyond people's volitional control. Thus, situational factors 'such as economic constraints, social pressures and opportunities to choose different actions' (Hines *et al.*, 1986/87, p. 7) may interfere with one's attitude. For instance, recycling opportunities affect the amount of recycling behavior (Guagnano *et al.*, 1995 cited in Kaiser *et al.*, 1999). Such situational influences can be considered in at least three different ways. First, perceived control, proposed by (Ajzen and Madden, 1986) as an indicator of actual control, can be used as a predictor of ecological behavior. Second, moderators of the relationship between environmental attitude and ecological behavior may be scrutinized. Because moderators represent conditional aspects of a given relationship, non-volitional behavior constraints that affect such a relationship can be chosen as moderators (e.g. residential area or season). Third, an ecological behavior measure that quantifies ecological behavior difficulties can be used as the outcome measure. **Perceived control**

In the ecological domain, different concepts of perceived control are used; for instance, internal locus of control, self efficacy and feelings of powerlessness (Kaiser *et al.*, 1999). None of them, however, indicate people's actual control rather, they represent different predictors of either ecological behavior or ecological behavior intention (Kaiser *et al.*, 1999).

Unfortunately, the relationship between perceived control and ecological behavior is inconsistent and ranges from slightly negative (Grob, 1995) to nonexistent (Gamba & Oskamp, 1994) to very positive (Auhagen & Neuberger, 1994).

#### 2.2.7. Factors That Influence EL: What does say research?

A number of studies have been conducted, in particular in developed countries, to test the awareness, attitude and behavior of students toward environmental issues in general and environmental problems challenging humanity in particular. Problems like pollution, the green house effect, acid rain, and ozone layer depletion are most frequently addressed by the

researchers. On the other hand, reports from developing countries on the state of students' knowledge and attitude towards the environment and environmental problems seem to be inadequate (Aklilu, 2006). Likert –type scale has been widely employed by the researchers to measure students' attitude towards environmental issues. Knowledge and awareness, on the other hand, have been measured by administering instruments of different forms including free-response, multiple choices, and true-false type tests. In some cases, attempts were also made to examine changes in students' behavior or development of a new behavior as a result of exposure to some kind of environmental education.

Furthermore, almost all of the studies have tried to explain the pattern of knowledge acquisition, attitude development and change and /or development of behavior against some independent variables like students age, sex, grade level, residence background (rural/urban), academic stream (natural/social science), religious affiliation, mass media diffusion, political activism, parental occupation and income ( Ibid,2006).

In another summary, despite the large number of studies and their theoretical variety (Stern, 1992 , Dietz et al 1998) identified two basic lines of research.

One of these research lines has concentrated its efforts on identifying the socio demographic factors associated with environmental concern (e.g., gender, age, educational level or political ideology). A second one has focused on the more purely psychological determinants (i.e., values, attitudes, and beliefs) of such environmental concern. The results with both approaches have been abundant and quite varied.

In the case of the socio demographic studies, they can be grouped around six basic issues (Dietz et al., 1998 ) that refer to variables such as age and cohort; education, political ideology, and place of residence; race and ethnic group; income, social class, occupation, and industrial sector; gender; and finally, religion. As a result, we find – within what has come to be called western civilization – that young women, with high educational level, liberal ideology, living in cities and actively involved in organized religion represent, from a socio

demographic perspective, the *ideal profile* of the person concerned about the environment (Dietz et al., 1998; Fransson & Gärling, 1999).

As regards the second line of research on environmental concern (psychological determinants), authors agree that such research has developed on the basis of three types of orientation that determine the subject's motivation to be concerned about the environment (Axelrod & Lehman, 1993; De Young, 1996 cited in Berengue and others ,2005): (1) orientation toward the environmental values within one's own society, (2) orientation toward care of the environment as the reflection of altruistic behavior, given the impact that its deterioration may have on the people that are important to us, and (3) orientation driven by egoistic motives, given the enjoyment of the comfort and convenience obtained from the exploitation of natural resources.

The present study aims to explore the links between certain social structures and environmental knowledge, attitudes, and behavioral actions in Ethiopian context.

In sum, the study seeks to explore the relationships between place of residence (rural vs. urban), gender (male vs female), academic stream (natural vs social science back ground), year level (year I vs II vs III) against the level of environmental literacy components- knowledge, attitudes, and practice /behaviors.

### **2.6.1 Early childhood experience and adult role model**

Some scholars such as Tanner (1980) and Chawla (1998, 1999) have examined the impact that childhood experiences of nature as well as the role that adult role models play in children's formation of environmental attitudes. The primary method used by researchers in this area employs autobiographical memories that examine adult recollections of the significant experiences that influenced their environmental concern.

In most of the research reviewed, positive experiences in nature, family members and teachers (who set examples of attention and respect for the natural world), books and other media and experiences of habitat destruction are common formative experiences that

influence individual's environmental concern (Chawla, 1998). While contact and experience with nature emerges as one of the most significant influences in the studies reviewed, Chawla argues that "free encounters with the natural world are becoming inaccessible to more and more young people in an increasingly urbanized world" (1998:20). Therefore it is critical that we utilize other mediators and means to inspire youth environmental concern.

Adult role models also play an important role in fostering youth environmental attitudes and behaviors. Research indicates that modeling is an effective way to teach knowledge and skills, and also encourages the development of certain values (Cangemi and Kahn, 1979).

In their recent qualitative study, Higgs and McMillan (2006) examined four schools that use a modeling approach to teach their students to "understand and respond to complex environmental issues in a way that promotes environmental responsibility. The results indicate modeling environmentally conscious behavior allows schools to foster learning about sustainability and the adoption of sustainable behaviors.

#### **2.2.7.1. School Curricular Background and Instruction mode**

The promotion of citizenship education, often for adults as well as school children, is typically identified as the primary task of schooling. A continuing assumption is that the success of the formal education system is essentially defined by its ability to prepare individuals to be citizens--i.e., to function effectively in today's and tomorrow's society (America 2000, 1991). Research indicates that as little as one course in environmental literacy produces more environmentally responsible behavior (Rowe, 2002, Wolfe, 2001).

Benton (1993) found that MBA students who took an environmental management course were more aware of environmental issues and more willing to take actions to make a positive difference. Smith-Sebasto (1995) found a significant increase in environmentally responsible behavior among students who took one course in environmental literacy in comparison to those with no course on this topic. Rowe (1999) found that students who had an interdisciplinary course with a focus on creating a more humane and environmentally

sustainable future developed an increased caring about the future of society, an increased belief that they can make a difference and an increased willingness to participate in solving societal and environmental problems. However; according to Disinger (1982), environmental education in nontraditional non-formal settings is expected to be more effective than traditional classroom programs in changing environmental behavior. Zelezny (1999), who presents the analysis of 22 studies on educational interventions, also agrees that EE could improve environmental behavior. However, unlike Disinger (1982), the author states that interventions in non-traditional settings (such as outdoor camps, etc.) are less effective because of the short-term nature of most visits, and the fact that many visitors are adults, whose behavior is less easy to influence or change. According to the researcher, programs that target young learners and are longer in duration tend to be more effective in changing environmental behavior of the participants.

#### **2.2.7.2. Academic stream and year level**

University students majoring in natural sciences were known to have more environmental knowledge than those majoring in social sciences (Gifford et al, 1982 cited in Aklilu, 2006)

#### **2.2.7.3. Gender**

Previous research in environmental sociology and psychology have examined the role of gender as one interacts with environment and while there is a tendency for women to be more concerned about the environment than men, the results are modest (Davidson and Freudenburg, 1996, Mohai, 1997). Gender can be understood both at macro level as a position in the social structure in which a category of people is expected to behave in a particular manner (Ridgeway, 1993), and at the micro level, as an identity (a set of self meanings) that person apply to themselves given their gender identifications (Stets and Burke, 1996). The distinction between the two is that while one may label herself female, she may see herself, not in a stereotypically female manner ( e.g ...expressive and submissive) but in some what stereotypical male fashion (e.g .. instrumental and dominant) . In this way social structural expectations attached to gender influence behavior as well as self perceptions along with

feminine –masculine continuum (one's gender identity) .Since gender at macro and micro level is simultaneously produced and maintained in situations ( Stets and Burke, 1996), we expect both to influence environmental behavior.

Environmental studies have shown that women tend to express high levels of concern for the environment than men ,though the findings are somewhat mixed (Davidson and Freudenburg ,1996).The explanation that has received the most consistent support as to why women express high levels of environmental concern is that women *care more* about the health and safety of their families and communities that men do ( Ibid,1996). Caring is believed to be an orientation that women adopt than do men (Cancian and Oliker, 2000). Indeed, the roles that women occupy in the society, such as domestic worker, and primary caretaker, foster a concern for the welfare of other people (Ibid, 2000). This orientation would encourage pro-environmental attitude and pro-environmental behavior.

The mixed support for gender and environmental outcomes may be due to the fact that one's environmental attitudes and behavior may have less to do being female or male ( being a member of social category ) and more to do with the meanings that people attribute to themselves as masculine or feminine(their gender identity). While masculinity is *agency focused* - emphasizing competition and interdependence, femininity is *communion oriented* – highlighting sensitivity and a concern for others (Eagly, 1987). Identity theory assumes that people choose behavior that is similar in meaning to the meaning of their identities (Burke and Reitzes, 1981).Therefore; we would expect environmental responsible behavior to be linked more to femininity than masculinity.

Prior research has shown that gender identity (or role identity-the meanings individual attribute to themselves in the role of male or female), in addition to gender, is a good predictor of behavior. For example, studies on conversational behavior have found that the inconsistency as to whether men use more dominant and assertive speech patterns than women (James and Clarke, 1993) could be resolved by examining gender identity , rather than

gender (Spencer and Drass, 1989). Masculinity predicted more dominant and assertive speech patterns, rather than being male doing so.

#### **2.2.7.4. Growing area: rural-urban**

The diverse backgrounds of young people today are reflected in their perceptions of environmental problems, their knowledge of environmental issues and their experiences with the environment in everyday life. In order to explain environmental behavior, it is necessary to understand the social context in which individuals develop it (Corral-Verdugo, 2001; Vorkinn & Riese, 2001 cited in Berengue and others, 2005). Despite the fact that one of the principal developments of the study of environmental concern has focused on defining the relationships between socio demographic variables and environmentalism, studies of how it is affected by place of residence have been scarce (Arcury & Christianson, 1993) and inconsistent. While some studies have argued that environmental concern is higher in cities (Van Liere & Dunlap, 1981), that urban residents are more concerned about the over-exploitation of natural resources (Arcury & Christianson, 1990), and that the perception of environmental problems increases with size of place of residence (Samdahl & Robertson, 1989), others have found that, after controlling for the rest of the socio demographic variables, there are no attitudinal or behavioral differences between the two types of sample (Arcury & Christianson, 1993). In another study, by Berengue and others (2005) in Spain, People living in the rural context show more attitudes of environmental responsibility and greater consistency on expressing behavioral intentions compatible with the protection of the environment.

With regard to place of residence, Corral-Verdugo (2001, p.168) cited in Berengue and others (2005) points out that: ". . . with rare exceptions, it is typical of these studies that the authors do not bother to explain why the inhabitants of rural areas or small communities are not so concerned with environmental problems, nor so oriented toward pro ecological actions."

### 2.2.7.5. Age

American and European researchers (e.g. Disinger 1982; Eagles and Demare 1999; Kamaneva *et al.* 1991; Lysenko 1993; Marcinkowski 1987; Nikolaeva 1992, 1993; Sia 1984; Tilbury 1994; Uzzel 1999; Wilson 1996; Zelezny 1999, etc.) emphasize that the development of EE is a continuing process that takes place during the whole life of an individual. But the starting point for it is the earliest stage of the formation of personality when environmental values and a positive attitude towards environment are built. Wilson (1996) identifies two main reasons for beginning EE during the early years of a child's life. Her premises focus on the conservation of nature and the healthy development of a child. The first reason is that if a child does not develop a sense of responsibility, respect and positive attitude towards nature during his/her childhood, he is liable not to form such attitudes later in life. The idea of existence of critical periods for the development of environmental attitudes and values is supported by Stapp (1978), and Tilbury (1994). They emphasized that if a child develops a negative attitude towards the environment, it is hard to change such an attitude later. A second reason for beginning environmental education in the early years is that a child needs healthy positive interactions with the natural environment (Carson 1956; Wilson 1996). A child uses the environment as a source of wonder, joy, and knowledge (Nikolaeva 1992, 1993; Sobel 1993, 1998).

Sobel (1993, p. 52) believes that childhood is a "critical period in the development of the self and in the individual's relationship to the natural world." Small children tend to construct "special places" and investigate their world starting from their neighborhoods and expanding the area of their interest later. By doing this they explore the world around them and their place in it. Thus, environmental education in the early years should focus primarily on young children exploring and enjoying the world of nature under the guidance of adults (Lysenko 1993; Sobel 1991, 1998; Vygotskiy 1991).

However; a recent study, in USA, found that children today spend an average of 6 hours each day in front of the computer and TV but less than *4 minutes a day* in unstructured outdoor

play, leading researchers to discover a new condition specific to this current generation that they have called "nature deficit disorder." This extreme emphasis of indoor time spent in front of screens versus outdoor play and discovery has been correlated with negative psychological and physical effects including obesity, loneliness, depression, attention problems and greater social isolation due to reduced time with friends and family (Sobel, 2004).

#### **2. 2.7.6. Media exposure**

The formal field of environmental education has never quite come to grips with the undeniable power of the media as both a positive and negative source of environmental information and knowledge. The common view among environmental educators is that the media does not supply much actual *education*; instead, the media is a powerful form of environmental *information or main tool for creating wide spread environmental awareness including government action in environmental policy and management*. The result of this view is that environmental educators tend to focus on education programs and to largely ignore how the media affects baseline public environmental knowledge. By contrast, organizations that have a strong stance as advocates for environmental protection often employ the media as a principal tool of public communication and have less patience for or interest in formal pedagogy.

The NEETF/Roper data over the past decade, by Coyle (2005), strongly imply that the media's impact on environmental knowledge should be taken more seriously and not ignored or underestimated by educators. That is because the media supplies a steady stream of sometimes complex and sometimes oversimplified environmental information that lands upon a fairly sketchy and unreliable base of pre-existing environmental knowledge. One study explains this by comparing the effect of television vs. classroom instruction. Students who relied on television as a source of information showed greater knowledge about global warming but also held more misconceptions. Students who reported learning most about the greenhouse effect from school held fewer misconceptions (Boyes & Stanisstreet, 2001b).

It is not that the media is supplying incorrect information; rather, individuals assimilate sound bites and information in their own unique way and according to their own unique worldview.

In other words, the public becomes informed about environmental issues through the mass media, such as newspapers, radio, television, and the world-wide web. These can be effective means of environmental education, but there are downsides. Media presentations of environmental issues are sometimes biased and inaccurate, and there is typically a focus on controversy, particularly issues involving scientific uncertainty and social conflict. This can result in high-profile disputes dominating the environmental agenda, which may detract from efforts to deal with important, well-known problems.

In general, though usually, questions concerning their scope remain unanswered that is do they affect all or just a few ecological behaviors moderators like gender, socio-economic status, mode of behavior assessment, group membership \_environmentalists vs non-environmentalists, income, access to recycling programmes , season and nationality affect environmental literacy . All these moderators represent different sorts of non volitional, socio-cultural behavior constraints.

#### **2.2.8. University and Environmental Literacy**

One important way of achieving a high level of environmental literacy in society is to ensure that relevant issues are solidly addressed in the educational system. Ideally, this exposure should occur throughout life, from primary and high schools, through colleges and universities, to continuing education for adults.

Agenda 21 (UNCED, 1992), for example, which is the blueprint for action adopted by the world's leaders including Ethiopia at the 1992 United Nations Earth Summit, calls for colleges to implement a general environmental education program to accomplish environmental literacy through integration in courses that reach across the curriculum. As a result, environmental education in colleges and universities is neither new nor unique as

Colleges and Universities have been challenged by international mandates such as Agenda 21 to increase their role in developing environmental literacy in all graduates.

Historically, environmental studies and sciences programs were first established in the early 1970s after the first Earth Day, a response to the growing public awareness of environmental studies and sciences issues. Almost one third of all existing environmental education programs were formed between 1970 and 1974; another third were instituted from 1990 to 1994, following Earth Day's 20th anniversary (Strauss, 1996).

The number of environmental studies programs continues to rise in institutions across the world offering majors in environmental fields (environmental studies, environmental sciences, environmental biology, environmental engineering, environmental education, environmental health sciences, environmental engineering technology, and environmental design to mention a few). However, all specialized environmental programs will reach only a minority of undergraduates. Students who do not major in environmental sciences or studies or who do not elect an environmental course will miss an opportunity for developing responsible behavior toward human and nature relationships (Ibid).

A central challenge of 21st Century society is to bring the nature and scope of the human endeavor into a sustainable relationship with the biosphere. As an important contribution to meeting this challenge, environmental literacy -- the ability to think critically about the environmental, social and economic dimensions of human-environment interactions and make responsible life choices -- should be a basic competency for all university graduates.

Governments as well as international organizations are interested in developing environmental and ecological literacy with the hope that if students are taught about the environment in general, their personal impact on the planet and to think critically about status in their careers and became supporters for environmentally friendly innovations. Institutions will eventually be pervaded by a new mindset that makes decisions in harmony with the environment rather than simply to meet institutional goals.

Since universities are charged with shaping students to become part of our society, it is vital that they be the forerunners in creating a culture of environmental stewardship in our society. Further, University graduates are currently causing many of the world's environmental problems, in David Orr's (1992, p.149) words "environmental mismanagement is often the works of the highest educated people with BA/ BSc, LLB, MA/MSc and PhD."

## **CHAPTER-THREE: METHODS AND PROCEDURES OF THE STUDY**

This chapter presents the description of the population of the study, the procedures employed in the development of data collection instruments, administration and scoring, and methods of data analysis.

### **3.1. Methodological Approaches**

The purpose of the study was to analyze the level of environmental literacy (EL) - knowledge, attitude and practical action- in undergraduate University students, and to examine differences in scores on components of environmental literacy by gender, academic stream, growing area, class standing or year levels and age sub populations. The stated objective demands research questions that enable to generate mostly numerical data supplemented by some non-numerical data.

To this effect, a blend of quantitative and qualitative research methodology (mixed approach) was employed with the assumption that they can help to understand or describe better the existing beliefs, attitudes, opinions and practices of a population by studying a sample of that population. In fact, the possibility of utilizing the mixed approach in the same studies is well recommended. For instance; Gay and Airasian (2000) noted that when the administration of a questionnaire (quantitative descriptive or survey) is followed by a small number of interviews or discussions (qualitative), the researcher will obtain deeper explanations of evidences or required data.

### **3.2. Variables of the Study**

**Variables** -are the conditions or characteristics that can take on different values or categories and the researcher observes (Johnson and Christensen, 2004).

### *3.2.1. Independent variables*

The variables that are presumed to cause changes in the extent of environmental literacy in this study were: education system (year level, academic stream), gender, age, rural-urban background and source of environmental information.

### *3.2.2. Dependent variables*

Environmental literacy and its components- knowledge, attitude and practice- whose magnitude and strength are influenced by independent variables were the dependent variables of the study.

### *3.3. Sources of Data*

To achieve the objective of the study both primary data (mainly students and their instructors, department heads and faculty deans) and secondary data (document analysis) were considered. Moreover; MOE education programme and EPA EE expert were also consulted for policy issue information and strategic implementation.

### *3.4. Study Site and Target Population*

Bahir Dar University (BDU) was selected as a place where to conduct this research due to (1) the experience of the researcher as a student in the campus, (2) presence of my ex-classmates as an academic staff in the university, and (3) being one of the educational institutions in the country over two decades. Therefore, the researcher selected this University by considering the collaboration of teachers, students and administrative staffs in providing genuine information for the success of the research.

Faculty of Education (FOE) at BDU is organized in thirteen departments accommodating 3580 male and 910 female (total =4490) students in the academic year 2007/08 from year I to III. FOE was selected on conviction that its graduates will engage in teaching learning profession after graduation and will have the opportunity to influence the school community at large so that predicting their level of environmental literacy scientifically will enable to

guess the likely impacts that they bring about on their students in the future career about environment and sustainable development.

### *3.5. Subjects of the Study and Sampling Technique*

The subjects of the study were Chemistry, Biology and Geography departments' undergraduate regular students from year I to III in the academic year 2007-08.

From the total number of education departments in the university; nearly one fourth were included in the study by purposive sampling method in favor of Heimlich (1992) and Filho (1993) suggestion who acknowledge that subjects such as chemistry, biology and geography, whose subject matters are essentially environmental, are more important to address environmental and ecological issues. That is, these host subjects present the knowledge, concern and skill that enable the learner to express and manipulate his/her environment.

The total number of students in the three departments were females=280, males = 1115, total= 1395. That is chemistry (female =56, male=337, total=393), geography (female =144, male=, 402, total= 546), and biology (female =80, male= 376, total=456).

From the total number of, year I to year III, 1395 students enrolled in three departments, the required sample size was determined using the formula recommended by Krejcie and Morgan (1970) and Gay and Airasia (2000) (see Appendix I). Accordingly, the sample size was 302. Furthermore proportional stratified sampling method was employed taking departments as a stratum. This means, from 1395 students, 118 geography, 99 biology and 85 chemistry (total =302) students were included in the study. Moreover; since each department has two or more groups of students (section A, B and C) per each year level, only one group was randomly selected. Moreover; the group that had participated for pilot study was intentionally excluded.

### *3.6. Instruments of Data Collection*

With the intention of assessing undergraduate students environmental knowledge, attitude practice, and overall environmental literacy index, three types of data gathering instruments namely questionnaire, FGD and Interview were constructed and employed.

### **3.6.1 Questionnaire**

The researcher used questionnaire so as to obtain information about the thoughts, feelings, attitudes, beliefs, values, perceptions, behavioral intentions and actions of research participants about environmental literacy and its components. The questionnaire consists of five sections (Appendix A).

#### **3.6.1.1. *Demographic and academic background information***

This section included questions about students' background: age, gender, academic stream, year level, and residence background or growing area.

#### **3.6.1.2. Sources of information on Environmental issues**

The participants were asked to what degree some different sources contribute to what they currently know about environmental issues, and the attitudes they have in the environment using a Likert- scale type questions with four possible answers (1- not at all, 2- a little, 3 – quite a bit, 4- very much).

#### **3.6.1.3. Environmental knowledge assessment**

The environmental knowledge of the ELS refers to the cognitive subscale that consists 14 multiple- choice questions that measure respondents' knowledge of basic ecological concepts, environmental problems and action strategies. Correct responses were assigned a score of four and incorrect responses a score of zero. The lowest possible total score is zero and the highest score is 56 (14x4).

#### **3.6.1.4. Environmental attitude inventory**

The environmental attitude section of the ELS refers to the affective subscale from NEP which was further modified to consist of 16 questions that measure respondents' attitudes toward environmental and efficacy beliefs, some of which can be identified as behavioral intention items. The responses were scored utilizing a Likert- scale type (strongly agree to strongly disagree) with the least desired environmental attitude being assigned zero, and the

most preferred response being a four (that is 0=strongly disagree; 1=disagree; 2=undecided; 3=agree; and 4=strongly agree). The higher a respondent's score, the higher the level of environmental attitude in the respondent. The lowest possible total score is zero and the highest score is 64 (16x4).

#### **3.6.1.5. Environmental practice inventory**

This section consists of 15 questions that measure the respondents' frequency of participation in their local environments (self reported behaviors). The responses were scored utilizing a Likert- scale type (never- to- usually) with no demonstrated environmental behavior response being assigned a zero, and the most demonstrated environmental behavior response being a three (that is 0= never; 1= rarely; 2= sometimes; and 3= always). The higher a respondent's score, the more actively engaged the respondent is in environmental practical actions. The lowest possible total score is zero and the highest possible score is 45 (15x3).

#### **Environmental Literacy composite score**

Environmental Literacy is determined by summing up the three scores from the three sub-scales for each respondent. The lowest possible total score is zero and the highest possible score is 165 = (56+64+45). This score is utilized only to analyze differences in subpopulations.

#### **3.6.2. Interview and FGD**

Though the main data gathering instrument was questionnaire, Interview and FGD were also held with the aim to get general and supplementary information from pertinent bodies and participants (Appendix D & appendix E).

### ***3.7. Procedures of Instrument Development***

The items included in the environmental literacy survey questionnaire of the present study were largely based on the review of related literatures, adaptations of other works and personal experience of the researcher.

### **3.7.1. Item Screening and Validation**

The selection of relevant items and the validation of the instruments involved expert opinion, pilot test and statistical methods of item analysis.

#### **3.7.1.1. Expert Opinion**

As far as the knowledge of the researcher is concerned, it is difficult to get standard tests to measure environmental literacy in Ethiopian context. As a result the researcher forced partly to adopt and construct himself items and invite subject specialists.

In this study, five experts in the rank of lecturer (2) and assistant professor (3) from Environmental Education, Measurement and Evaluation, test developers from GEQAEA and Teaching English as a Foreign Language (TEFL) were involved. The task of experts from the TFEL was to improve the clarity, wording, phrasing and appropriateness of the items as measures of environmental literacy. The role of experts from department of Environmental Education, Measurement and Evaluation, National Examination agency were to comment on construction, relevance and appropriateness of each items based on their knowledge and to rate each items into highly (3), moderately (2) and poorly (1) according to the topic under consideration. Originally, a total of 70 items (23 cognitive issues, 22 affective issues, 23 practical action activities and 2 general items) either constructed by the researcher or partly modified, adapted and / or adopted version form of Melaku (1994), Coly (2005), Damitew (2007), Asmare (2007), Kaiser et al (1999) and Dunlap and et al (2000) were given to the experts (see Appendix C). Based on the overall assessment made by this group, among the seventy items, fifty four items (18 cognitive issues, 18 affective issues, 17 practical action activities and 1 general source items) which received a mean rating score of 2.0 and above, were retained as good, while the rest were discarded. The retained fifty four items were retained for further screening and validation. Therefore, fifty-four items were made ready for the pilot-test of the instrument (see Appendix B).

### 3.7.1.2. Pilot Test

Following the design and preparation of each of the instruments, particularly the questionnaire for students, a pilot study was conducted with the aim to : 1) check the overall organizational structure of the test and to generate data for the statistical item analysis procedure, 2) determine the administration time, 3) ensure that the items of the scales and questionnaires can be understood by the participants, 4) determine the appropriateness of the response sheets, 5) determine sequence of administration, and 6) make necessary amendments based on the obtained feedbacks from respondents.

The items used in the pilot study were the fifty-four items retained from the judgment of the experts (as content and construct validity) and additional items of biographical data. In the test, the items were intentionally distributed in their respective specific clusters from part one to part five. Moreover, the items were arranged in the form of multiple choices for knowledge assessment, likert- scale in five-points for attitude and likert- scale in four-points for behavioral practice inventory. Then the instrument was tried at a randomly selected thirty - two BDU students enrolled in Biology, Chemistry and Geography departments.

### 3.7.1.3. Item Analyses

Following the pilot test, data was entered in to data editor window using SPSS 15 .0 for windows to test the reliability or internal consistency (alpha) of the items and their inter-item average correlations of the items belonging to the same construct in their respective categories.

Cronbach Alpha ( $\alpha = 0.05$ ) was applied and interpreted using Nunnally and Bernstein (1994) guidance who assert that a reliability coefficient of .70 or higher is considered "acceptable" in most social science research situations or sufficient for early stages of research. Cronbach's alpha is the most common form of internal consistency reliability coefficient. Alpha equals zero when the true score is not measured at all and there is only an error component. Alpha equals 1.0 when all items measure only the true score and there is no error component. Cronbach's alpha can be interpreted as the percent of variance the observed scale would explain in the hypothetical true scale composed of all possible items in the universe.

Alternatively, it can be interpreted as the correlation of the observed scale with all possible other scales measuring the same thing and using the same number of items.

### **3.7.1.3. 1. Knowledge subsection**

Application of SPSS for 18 environmental knowledge items (Appendix F) yield an overall alpha for the entire scale ( $\alpha = .628$ ) and a weakly item-total correlation for items 2, 5, 9, 10 and 14 which suggest that either these items should be eliminated or re written. Step by step removal of items 2, 9, 10 and 14 respectively and re-run the reliability analysis gave an overall Cronbach alpha = 0.707 which is acceptable according to Nunnally and Bernstein (1994). As a result 13 items (item 1,3,4,6,7,8,11,12,13,15,16,17 and 18) were accepted as they were and item 5 was rewritten taking in to consideration the experts opinions . Over all 14 items that assess students' environmental knowledge were approved to be used for final work.

### **3.7.1.3. 2. Practical action subsection**

Similar to Knowledge subsection, 17 items that are adapted from General ecological behavior (GEB) suggested by Kaiser et al (1999) , were subjected to SPSS window for item analysis (Appendix E). They were slightly modified in relation to Ethiopian socio-economic and geographic context qualitatively.

Application SPSS for reliability test yield a Cronbach alpha = 0.720 (Appendix F). Though the reliability coefficient ( $\alpha = 0.720$ ) is acceptable, observing an inter item correlation matrix output of items 41 and 53 correlates negatively with most of the other items suggesting the need for elimination of such items from the scale and further re-run the reliability analysis. Removal of items 40 and 52 and an application SPSS for reliability test yield a Cronbach alpha=0.760. As a result 15 items (items 37,38,39,41,42,43,44,45,46,47,48,49,50,51 and 53) were retained for the final study of this project.

### **3.7.1.3. 3. Attitude sub section**

Originally an instrument that measures environmental attitude consisting of 12 items was constructed by Van Liere & Dunlap (1978). This instrument, also named as New Environmental Paradigm (NEP), was revised by Dunlap and et al (2000) and modified to

consist of 13 items whose validity and reliability is approved. Moreover; Albrech and et al's (1982) comment that the NEP has sufficient reliability to warrant its continual use and seen to be a valid measure of environmental attitude. As a result, with the acknowledgement of Dunlap and et al (2000), 13 items of the revised NEP scale measuring environmental attitude were adopted with slight qualitative modification as commented by experts and three additional items (item 17,29 and 30) were added.

Generally, after the various methods of screening and validations were employed, 45 items (14 cognitive related, 16 attitude related and 15 practical participation activities) for students were considered to be satisfactory to be used in the main study along with some demographic and source information (see Appendix A) variables.

Therefore, the investigator concludes that each of the items measure their respective categories with a satisfactory validity and reliability.

#### **3.7.1.4. Administration and Scoring**

The administration of the main instrument took place, at the begging of April, 2008. In the administration of the test, it was emphasized to the subjects about the crucial importance of their frankness and objectivity in their response to the items of the test. To that effect, the identity of the respondents was made anonymous and it was made clear that individual responses will be kept confidential. Moreover, it was stated that in their response to the items, there is nothing to be said right or wrong; thus, they do not need to be reserved.

The test was distributed during the regular classes and took approximately one hour. A total of 310 students returned the Environmental literacy survey questionnaire (310/345 x100 =90% return rate) since extra 45 questionnaires were distributed taking in to account students research experience and punctuality though highly advised during instrument distribution.

Finally 302 questionnaires from students were ready for data analysis. Though the return rate was adequate enough, the non response rate was 2.35% (missed values) which may affect somehow the result since the participants were from different demographic backgrounds. Moreover; negatively formulated items were reversed in coding.

### *3.8. Methods of Data Analysis*

The collected response sheets were given an ID code numbered from 001 to 302. Accordingly, data entry using excel 2007 worksheet was done successfully. Composite scores for each section and then for the survey as a whole were then summed up. Following coding and adding, the data was imported in to SPSS 15.0 for windows software for statistical analysis. Pearson's correlations were determined following tests to rule out multi- co linearity of the variables in each section.

Based on the observed correlations, principal component analysis (PCA) was undertaken to determine if specific factors or components were causing variability. One way-ANOVA procedures were used to test differences in the subpopulations on each of the subsections and for an overall environmental literacy index. Independent T-test was used to test difference in gender, age and stream categories. Unless noted otherwise all tests were made at  $\alpha = 0.05$  levels.

## CHAPTER-FOUR: RESULTS AND DISCUSSION

This chapter summarizes data presentation, research findings, discuss the results and suggest recommendations for further environmental literacy research in undergraduate regular students.

### 4.1 Presentation of Respondents' Results

#### 4.1.1 Demographic and Academic profile of participants

There were 302 respondents to the ELS, representing three academic majors: 39.1%, 32.8%, 28.1% of the respondents represent Geography, Biology and Chemistry respectively. Gender wise: 88.4% of the respondents were males and 11.6 % were females. Age wise; 12.3% were younger than 20 years of age and 87.3% were 20 years age and older. By growing are: 55%, 26.2% and 17.2% of the respondents, respectively, had rural, suburban and urban backgrounds. By class standing, 40.7% of the respondents were fresh man to the campus, 34.4% were second year (junior) and 24.8% were third year (senior).

#### 4.1.2. Sources of Information on Environmental Issues

##### *Research question one*

*What sources of information contributed to what they know about environmental issues and problems and the attitudes they have toward the environment?*

Table 4.1. Contribution of different sources of information

| N0 | Source of information                           | Mean | Standard deviation |
|----|---|------|--------------------|
| 1  | Various school education systems                | 3.15 | 0.905              |
| 2  | Electronic media (TV, radio etc)                | 3.04 | 0.906              |
| 3  | Printed materials (books, news paper, magazines | 2.94 | 1.99               |
| 4  | Age/self experience                             | 2.84 | 0.864              |
| 5  | Parents and friends                             | 2.79 | 0.921              |

Results show that the contribution of various school education systems (primary, secondary and higher education) is the major source of information, while parents and friends are relatively the minor.

#### 4.1.3. Level of Environmental knowledge, Attitude, Behavioral practice and Environmental literacy Index

##### *Research question two*

*How low or high are undergraduate University students' environmental knowledge, attitude and behavioral practice against MOE/ National Examination standards or scales?*

Table 4-2. Results of environmental literacy and its components as graded by MOE scale

| Sub-Section                  | Expected total          | Scored total | Mean | SD   | percentile | Grading scale | Item mean |
|------------------------------|-------------------------|--------------|------|------|------------|---------------|-----------|
| Knowledge                    | 14x4x302=16912          | 8868         | 29.4 | 8.9  | 52.4%      | C             | 2.1       |
| Attitude                     | 16x4x302=19328          | 12045        | 39.9 | 6.65 | 62.3%      | C             | 2.54      |
| Practice                     | 15x3x302=13590          | 6261         | 20.7 | 7.4  | 46.1%      | D             | 1.44      |
| Environmental literacy index | 16912+19328+13590=49830 | 27174        | 89.9 | 14.9 | 54.5%      | C             |           |

The mean of the knowledge section was distributed normally and had a mean value of 29.36 (52.4%). In order to put the mean scores in a true University context, a letter grade was also assigned for each section and for the overall ELS index score. However; BDU has no its own fixed grading system. As a result the researcher applied a common grading scale employed by MOE/GEQAEA which values: *A(100-80%), B(79-68%), C(67-50%), D(49-35%) and F(below 35%).*

On the basis of MOE generic grading scale BDU regular undergraduate students' rate barely a C in environmental knowledge. Knowledge is the mean scoring component of ELS (figure 4.1)

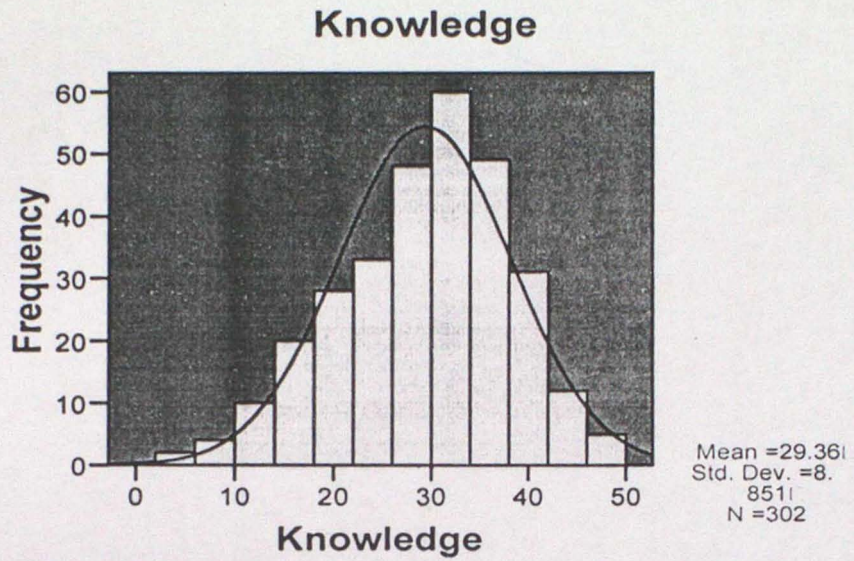


Figure 4-1. Histogram of the know ledge section of ELS

The overall mean score of for environmental attitude section of the ELS was 62.3(39.88%), which is a C on MOE grading scale. The responses were normally distributed as shown in figure 4-2. Yet, the attitude component is the highest mean score of the ELS.

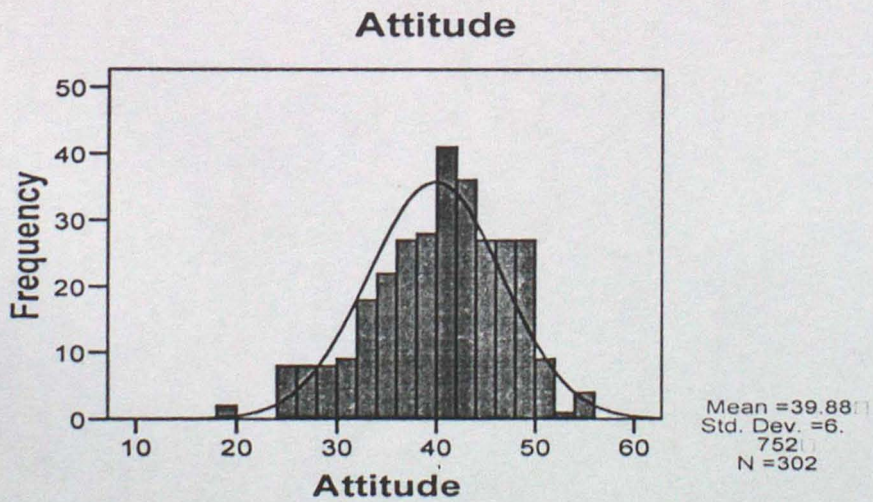


Figure 4-2. Histogram of the attitude section of ELS

Similarly, the mean of the behavioral action of ELS was distributed normally and had a mean of 19.27(42.83%), thus receiving a solid D on the generic MOE grading scale (figure 4-3).

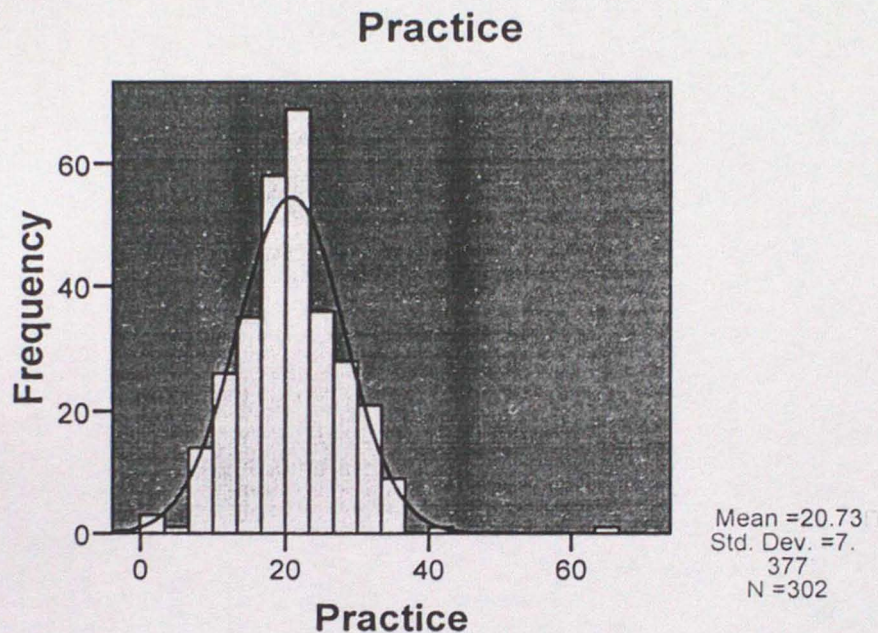


Figure 4-3. Histogram of the behavioral action section of ELS

Generally, the performance of participants in three domains (environmental knowledge, attitude and behavioral practice) seems not satisfactory. Similarly; in Asmare's (2007) study of ninth and tenth graders, secondary school students' performance in three domains were very low.

The Environmental literacy index, which is the sum of the environmental knowledge, attitude and behavioral practice sections, had an overall mean of 88.52 (53.65%) giving undergraduates a rating of C on the generic MOE grading scale (figure 4-4).

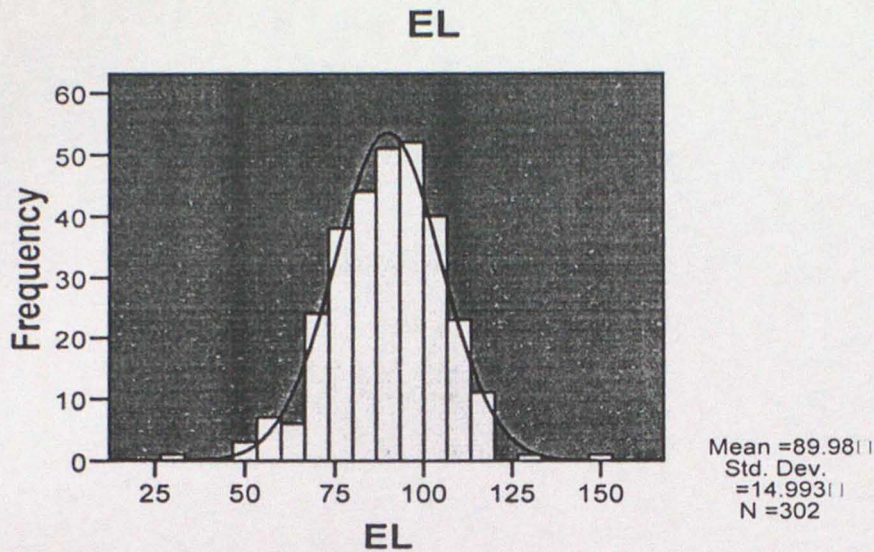


Figure 4-4. Histogram of the Environmental literacy survey (ELS)

Table 4.2 shows that undergraduate students at BDU have a higher environmental attitude score, followed by intermediate knowledge and very low practical participation. It is worth noting that since the practices were self-reported rather than observed, actual participations or engagements are lower or probably much lower. This trend is documented in Scott and Willits (1994, p.255) who found in their study of Pennsylvanians that participants expressed positive environmental attitudes but did not perform many environmental friendly practical actions. The observed low attitude-practice linkage may be less a result of questioning, wording or measurement error than a real disparity as a similar result is also noted by Diekmann and Preisendorfer (1998). Though this may be a discouraging, having a positive environmental attitude is a precondition to perform environmental friendly actions. Strengthening this, Scott and Willits (1994, p.240) state that

*Although people may be less likely to engage in environmental protecting behaviors than they are to express support for environmental principles, it, nevertheless, seems likely that those who hold the most supportive attitudes would be more inclined than those with less supportive attitudes to act in ways that protect the environment.*

#### 4.1.4. Multi-co linearity of components

##### Research question three

What is the extent of the relationship of an individual's score on the separate components of the environmental literacy survey (knowledge/cognitive, attitude/affective and practice/behavior)?

##### Results

There are several different methods for obtaining correlation coefficients depending on the type of data to be analyzed. In this study, Pearson moment correlation( $r$ ) which uses the actual value of the data to determine the extent of the linear relation was employed. Following to tests to rule out multi-co linearity, correlations were calculated. Results were judged on the basis of Gay and Airasian (2000) recommendation: correlation coefficient below plus or minus 0.35 low; coefficient between plus or minus 0.35 and 0.65 moderately related; and coefficient higher than plus or minus 0.65 highly related. Moreover; Jaeger (1983) cautions researchers to know what is typical of for their type of research when determining whether a correlation is weak, strong or absent and not arbitrarily abide by guide lines set by a statistical hand book. The calculated Pearson correlations were significant at  $\alpha = 0.01$  level (2-tailed-) except for the attitude –behavioral practice which was not significant.

Results indicated, in both cases, that there is a very weak correlation between the components. That is knowledge vs attitude ( $r = 0.190$ ), knowledge vs practice ( $r = 0.175$ ) and attitude vs practice ( $r = 0.008$ ). There was an insignificant relationship between attitude and behavioral practice. The results are presented graphically in fig.4.5

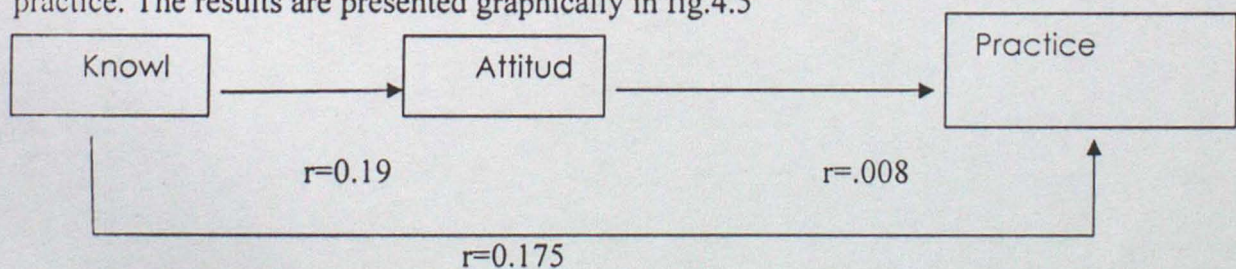


Figure 4.5. Relationship between environmental knowledge, attitude and behavioral practice

Overall, the bivariate correlation coefficients are very low, probably; the homogeneity of the group can affect the correlations. If a group is sufficiently homogeneous on either or both variables, the variation will tend toward zero. However; these correlations are slightly consistent with values reported in the literature but in order to rule out any problems with specific variables, principal component analysis was performed for each section.

### **Principal component analysis (PCA)**

PCA is indicated when an investigator assembled a set of items (say 20 to 50) designed to measure some construct (e.g attitude toward educations), (Stevens, 1996, p.362). The component that has the largest Eigen value, that is the one that explains the maximum variance, is the principal component. The number of components that can be generated for a model is usually the number of variables in the model. Conventionally components that have Eigen values above one are considered. According to Stevens (1996), a good component will have four or more loadings above 0.60 or about 10 or more low loadings of 0.40.

Factor loadings are a mathematical relationship between the individual variable and component. This indicates the variables that are loading, that is, that are well-related to each component. This allows the researcher to determine if there is a specific construct underlying a particular component (Stevens, 1996). If the researcher can identify a construct for a component, then they have succeeded in narrowing down the number of factors in the models. The hope is that a few components will explain most of the variability in the model, for example four or five components should explain 75% of the variance. To determine which variables to keep in the model based on factor loading, Stevens (1996) recommends using only loadings that are greater than 0.40 for interpreting factors. Having this theoretical information application of SPSS revealed the following facts.

In the knowledge section, the six extracted components accounted for 57.3 % of the variability (Appendix G) which is not as high as usually hoped for with PCA that is, four or five components should explain 75% of the variance. Item C8 ,C<sub>10</sub>,C<sub>3</sub>,C<sub>13</sub>,C<sub>9</sub>,C<sub>4</sub>,C<sub>1</sub> (Appendix A) all failed to load highly on component1 . The knowledge section did not meet the

requirement given by Stevens (1996) for a good component as there were not several items loadings above 0.60 or ten or more items loading above 0.40. Thus, no groupings of variables were necessary for the knowledge section.

In the attitude section, the six extracted components accounted for 57.79 % of the variability (Appendix G). The attitude section did not meet the requirement given by Stevens (1996) for a good component as there were not several items loadings above 0.60 or ten or more items loading above 0.40. Thus, no groupings of variables were necessary for the attitude section.

Similarly, in the behavioral practice section, the five extracted components accounted for 55.53 % of the variability (Appendix G). Like the attitude section, the behavioral practice section did not meet the requirement given by Stevens (1996) for a good component as there were not several items loadings above 0.60 or ten or more items loading above 0.40. Thus, no groupings of variables were necessary for the behavioral practice section.

In summary, PCA results of Appendix G depict that a specific construct (model) underlying a particular component cannot be identified or no variable could be discarded from the model based on the qualitative interpretation of the factor loadings. In other words; the hope that a few components will explain most of the variability in the model, for example four or five components should explain 75% of the variance, could not apply here.

#### **4.1.5. Subpopulation analysis**

##### ***Research question four***

Will there be a measurable difference in subpopulations (male/female, rural/urban, class standing/age, and natural science/social science) scores on the three components and the total score?

Table 4.3. Summary of the effect of moderators on respondents' performance

| Subpopulation by |            | N   | Knowledge |     |      | Attitude |     |      | Practice |     |      | Overall literacy |      | Environmental |  |
|------------------|------------|-----|-----------|-----|------|----------|-----|------|----------|-----|------|------------------|------|---------------|--|
|                  |            |     | Mean      | SD  | %    | mean     | SD  | %    | mean     | SD  | %    | mean             | SD   | %             |  |
| Age              | <20        | 37  | 25.3      | 8.1 | 45.2 | 38.2     | 6.5 | 59.7 | 20.9     | 6.8 | 46.4 | 84.4             | 15.0 | 51.2          |  |
|                  | >19        | 265 | 29.9      | 8.8 | 53.4 | 40.1     | 6.8 | 62.7 | 20.7     | 7.5 | 46.0 | 90.8             | 14.8 | 55.0          |  |
|                  | Total      | 302 | 29.4      | 8.9 | 52.5 | 39.9     | 6.8 | 62.3 | 20.7     | 7.4 | 46   | 89.9             | 14.9 | 54.5          |  |
| Gender           | Female     | 27  | 27.6      | 8.5 | 49.3 | 37.74    | 6.4 | 58.9 | 19.0     | 7.5 | 42.2 | 84.3             | 11.9 | 51.1          |  |
|                  | Male       | 275 | 29.5      | 8.9 | 2.7  | 40.09    | 6.8 | 62.6 | 20.9     | 5.7 | 46.4 | 90.5             | 15.2 | 54.9          |  |
|                  | Total      | 302 | 29.4      | .9  | 52.5 | 39.88    | .8  | 2.3  | 20.7     | 7.4 | 46.0 | 89.9             | 14.9 | 54.5          |  |
| Growing Area *   | Rural      | 166 | 30.5      | 8.2 | 54.5 | 39.8     | 6.5 | 62.1 | 21.5     | 7.5 | 48.8 | 91.7             | 13.7 | 55.6          |  |
|                  | Suburban   | 80  | 28.       | 9.7 | 50.0 | 40.3     | 7.2 | 63   | 20.4     | 7.3 | 45.3 | 88.7             | 16.0 | 53.8          |  |
|                  | Urban      | 51  | 28.4      | 9.2 | 50.7 | 39.1     | 7.1 | 61.1 | 19.4     | 6.4 | 43.1 | 86.9             | 16.9 | 52.7          |  |
|                  | Total      | 297 | 29.5      | 8.9 | 52.7 | 39.8     | 6.8 | 62.3 | 20.8     | 7.3 | 46.2 | 90.1             | 15.0 | 54.6          |  |
| Year Level       | Freshman-1 | 129 | 26.20     | 8.8 | 46.9 | 40.02    | 6.8 | 62.5 | 20.4     | 7.3 | 45.3 | 86.6             | 15.9 | 52.5          |  |
|                  | Junior-2   | 98  | 30.98     | 9.1 | 55.3 | 40.52    | 6.9 | 63.3 | 19.9     | 6.7 | 44.2 | 91.4             | 14.1 | 55.4          |  |
|                  | Senior-3   | 75  | 32.69     | 6.6 | 58.4 | 38.83    | 6.4 | 60.7 | 22.6     | 8.1 | 50.1 | 94.1             | 13.3 | 57.0          |  |
|                  | Total      | 302 | 29.36     | 8.9 | 52.4 | 39.88    | 6.8 | 62.3 | 20.7     | 7.4 | 46.0 | 89.9             | 15   | 54.5          |  |
| Dept             | Biology    | 99  | 28.69     | 9.1 | 51.2 | 39.64    | 6.8 | 61.9 | 21.3     | 7.4 | 47.3 | 89.6             | 15.8 | 54.3          |  |
|                  | Chem       | 85  | 26.73     | 8.2 | 47.7 | 40.18    | 7.1 | 62.8 | 20.5     | 8.0 | 45.6 | 87.4             | 14.6 | 53.0          |  |
|                  | Geo        | 118 | 31.83     | 8.4 | 56.8 | 39.88    | 6.4 | 62.3 | 20.4     | 6.9 | 45.3 | 92.1             | 14.4 | 55.8          |  |
|                  | Total      | 302 | 29.36     | 8.9 | 52.4 | 39.88    | 6.8 | 62.3 | 20.7     | 7.4 | 46.0 | 89.9             | 15   | 54.5          |  |
| Stream           | Natural    | 184 | 27.78     | 8.7 | 49.6 | 39.89    | 6.9 | 62.3 | 20.9     | 7.7 | 46.4 | 88.6             | 15.2 | 53.7          |  |
|                  | Social     | 118 | 31.83     | 8.5 | 56.8 | 39.88    | 6.4 | 62.3 | 20.4     | 8.9 | 45.3 | 92.1             | 14.4 | 55.8          |  |
|                  | Total      | 302 | 29.36     | 8.9 | 52.4 | 39.88    | 6.8 | 62.3 | 20.7     | 7.4 | 46.0 | 89.9             | 14.9 | 54.5          |  |

\* -5 respondents did not express their identity growing area , N= number of respondents, SD- standard deviation

#### 4.1.5.1. Age subpopulation analysis

Table 4.4. Independent t-test by age assuming equal variance

|                        | T     | Df  | Sig(2-tailed) | Mean difference |
|------------------------|-------|-----|---------------|-----------------|
| Knowledge              | 3.024 | 300 | .003*         | 4.635           |
| Attitude               | 1.635 | 300 | .103          | 1.932           |
| Behavioral practice    | .141  | 300 | .888          | .182            |
| Environmental literacy | 2.446 | 300 | .015*         | 6.384           |

\*P < .05

Table 4.5. ANOVA by age

|           |                | Sum of Squares | Df  | Mean Square | F     | Sig. |
|-----------|----------------|----------------|-----|-------------|-------|------|
| Knowledge | Between Groups | 697.427        | 1   | 697.427     | 9.143 | .003 |
|           | Within Groups  | 22884.507      | 300 | 76.282      |       |      |
|           | Total          | 23581.934      | 301 |             |       |      |
| Attitude  | Between Groups | 121.132        | 1   | 121.132     | 2.672 | .103 |
|           | Within Groups  | 13599.812      | 300 | 45.333      |       |      |
|           | Total          | 13720.944      | 301 |             |       |      |
| Practice  | Between Groups | 1.081          | 1   | 1.081       | .020  | .888 |
|           | Within Groups  | 16380.194      | 300 | 54.601      |       |      |
|           | Total          | 16381.275      | 301 |             |       |      |
| EL        | Between Groups | 1323.155       | 1   | 1323.155    | 5.984 | .015 |
|           | Within Groups  | 66334.725      | 300 | 221.116     |       |      |
|           | Total          | 67657.881      | 301 |             |       |      |

As shown in ANOVA table (table 4.5) and independent t-test table (table 4.4) environmental literacy and knowledge component were significant at  $p < .05$  based on participants age category.

In every section, the >19 subpopulation, survey respondents who are 20 years of age or older, mean scores were higher than the <20 subpopulation mean scores who are 19 years of age or younger (table 4.3). In the knowledge section >19 had a mean score of 29.9 (53.4%) and <20 had a mean score of 25.3 (45.2%) with a mean difference = 4.635.

In the attitude section >19 had a mean score of 40.1(62.7%) and <20 had a mean score of 38.2 (59.7%).

Similarly, in the behavioral practice section >19 had a mean score of 20.71 (46%) and <20 had a mean score of 20.89 (46.4%) almost the same.

In the overall environmental literacy index section >19 had a mean score of 90.8 (55%) and <20 had a mean score of 84.4 (51.2%) with a mean difference = 6.384.

This section suggests that older students had better scores in environmental knowledge and overall environmental literacy. Thus, there must be some increase in environmental literacy gained in time though it cannot be determined whether staying in university or some other variable may be the real cause since there is no formal literacy program at BDU.

#### 4.1.5.2. Class standing or year level subpopulation analysis

Table 4.6 ANOVA by year level

|           |                | Sum of Squares | df  | Mean Square | F      | Sig. |
|-----------|----------------|----------------|-----|-------------|--------|------|
| Knowledge | Between Groups | 2377.268       | 2   | 1188.634    | 16.761 | .000 |
|           | Within Groups  | 21204.666      | 299 | 70.919      |        |      |
|           | Total          | 23581.934      | 301 |             |        |      |
| Attitude  | Between Groups | 125.769        | 2   | 62.884      | 1.383  | .252 |
|           | Within Groups  | 13595.175      | 299 | 45.469      |        |      |
|           | Total          | 13720.944      | 301 |             |        |      |
| Practice  | Between Groups | 342.682        | 2   | 171.341     | 3.194  | .042 |
|           | Within Groups  | 16038.593      | 299 | 53.641      |        |      |
|           | Total          | 16381.275      | 301 |             |        |      |
| EL        | Between Groups | 2939.320       | 2   | 1469.660    | 6.790  | .001 |
|           | Within Groups  | 64718.561      | 299 | 216.450     |        |      |
|           | Total          | 67657.881      | 301 |             |        |      |

As with the age subpopulations analysis there were a significant difference at  $p < .05$  in environmental knowledge, and environmental literacy index. The mean difference was also significant for behavioral practice. Freshman had again the lowest mean environmental knowledge 26.2 (46.9%) followed by juniors with a mean score of 30.98 (55.3%) and seniors with a mean score of 32.69 (58.4%) (Table 4.3).

It is insightful that freshman would have the lowest knowledge score and that overtime, as a few sciences courses added; more likely, factual knowledge of environmental principles would increase. However; it is counter intuitive to explain the trend for behavioral practice as it is self reported behavior.

Like the knowledge component, it appears that over time in university, undergraduates do increase their overall environmental literacy index. This suggests that adding an environmental literacy program could bump up the natural increase in the environmental literacy index score that seems to result over time spent at university.

#### 4.1.5.3. Gender analysis

Table 4.7. ANOVA by gender

|           |                | Sum of Squares | df  | Mean Square | F     | Sig.  |
|-----------|----------------|----------------|-----|-------------|-------|-------|
| Knowledge | Between Groups | 96.998         | 1   | 96.998      | 1.239 | .267  |
|           | Within Groups  | 23484.936      | 300 | 78.283      |       |       |
|           | Total          | 23581.934      | 301 |             |       |       |
| Attitude  | Between Groups | 136.217        | 1   | 136.217     | 3.008 | .084  |
|           | Within Groups  | 13584.727      | 300 | 45.282      |       |       |
|           | Total          | 13720.944      | 301 |             |       |       |
| Practice  | Between Groups | 88.926         | 1   | 88.926      | 1.637 | .202  |
|           | Within Groups  | 16292.349      | 300 | 54.308      |       |       |
|           | Total          | 16381.275      | 301 |             |       |       |
| EL        | Between Groups | 957.902        | 1   | 957.902     | 4.308 | .039* |
|           | Within Groups  | 66699.979      | 300 | 222.333     |       |       |
|           | Total          | 67657.881      | 301 |             |       |       |

\* P<.05

Table 4.8. Independent t-test by gender assuming equal variance

|                        | T     | Df  | Sig(2-tailed) | Mean difference |
|------------------------|-------|-----|---------------|-----------------|
| Knowledge              | 1.113 | 300 | .267          | 1.986           |
| Attitude               | 1.734 | 300 | .084          | 2.354           |
| Behavioral practice    | 1.280 | 300 | .202          | 1.902           |
| Environmental literacy | 2.076 | 300 | <u>.039</u>   | 6.242           |

From the ANOVA table (table 4.7) and independent t-test table (table 4.8), there was no significant difference in environmental knowledge, attitude and behavioral practice. Only a slight significance difference ( $P < .05$ ) was observed in environmental literacy index by gender.

The mean knowledge score for males was 29.5 (40.1%) where as the mean knowledge score for females was 27.6 (37.7%) (table 4.3) but this difference was insignificant at  $p < .05$ . Similarly, the mean attitude score for males was 40.1 (62.6%) whereas the mean female score was 37.7 (58.9%) and this difference was also insignificant

#### 4.1.5.4. Growing area subpopulation analysis

Table 4.9 ANOVA by growing area

|           |                | Sum of Squares | df  | Mean Square | F     | Sig. |
|-----------|----------------|----------------|-----|-------------|-------|------|
| Knowledge | Between Groups | 410.295        | 2   | 205.148     | 2.648 | .072 |
|           | Within Groups  | 22773.651      | 294 | 77.461      |       |      |
|           | Total          | 23183.946      | 296 |             |       |      |
| Attitude  | Between Groups | 46.161         | 2   | 23.081      | .502  | .606 |
|           | Within Groups  | 13521.718      | 294 | 45.992      |       |      |
|           | Total          | 13567.879      | 296 |             |       |      |
| Practice  | Between Groups | 184.493        | 2   | 92.246      | 1.743 | .177 |
|           | Within Groups  | 15557.090      | 294 | 52.915      |       |      |
|           | Total          | 15741.582      | 296 |             |       |      |
| EL        | Between Groups | 1104.193       | 2   | 552.097     | 2.477 | .086 |
|           | Within Groups  | 65523.975      | 294 | 222.871     |       |      |
|           | Total          | 66628.168      | 296 |             |       |      |

Though the mean score of respondents with rural background looks slightly greater than respondents with urban backgrounds in all three domains (table 4.10), one way ANOVA results (table 4.16) revealed that there was no significant difference in any one of the components at  $p < .05$  on the basis of respondents growing area.

This may not be a surprising fact as the majority of respondents [Ethiopian people] have rural background, and hence homogeneity may lead to indifference among categories.

#### 4.1.5.5. Stream subpopulation analysis

Table 4.10 ANOVA by stream

|           |                | Sum of Squares | Df  | Mean Square | F      | Sig. |
|-----------|----------------|----------------|-----|-------------|--------|------|
| Knowledge | Between Groups | 1178.019       | 1   | 1178.019    | 15.774 | .000 |
|           | Within Groups  | 22403.915      | 300 | 74.680      |        |      |
|           | Total          | 23581.934      | 301 |             |        |      |
| Attitude  | Between Groups | .001           | 1   | .001        | .000   | .995 |
|           | Within Groups  | 13720.942      | 300 | 45.736      |        |      |
|           | Total          | 13720.944      | 301 |             |        |      |
| Practice  | Between Groups | 19.405         | 1   | 19.405      | .356   | .551 |
|           | Within Groups  | 16361.870      | 300 | 54.540      |        |      |
|           | Total          | 16381.275      | 301 |             |        |      |
| EL        | Between Groups | 892.750        | 1   | 892.750     | 4.011  | .046 |
|           | Within Groups  | 66765.131      | 300 | 222.550     |        |      |
|           | Total          | 67657.881      | 301 |             |        |      |

Table 4.11. Independent t-test by stream assuming equal variance

|                        | T     | df  | Sig(2-tailed) | Mean difference |
|------------------------|-------|-----|---------------|-----------------|
| Knowledge              | 3.972 | 300 | .000          | 4.048           |
| Attitude               | .006  | 300 | .995          | .005            |
| Behavioral practice    | .596  | 300 | .551          | .520            |
| Environmental literacy | 2.003 | 300 | .046          | 3.524           |

From the ANOVA table (table 4.10) and independent-test table (table 4.11), the knowledge component and the environmental literacy index were significant at  $p < .05$ . The mean knowledge score of natural science participants was 27.8 (39.9%) whereas the mean score of social science participants was 31.8 (39.9%) (Table 4.3) with a mean difference = 4.048.

Similarly, the mean environmental literacy score of natural sciences was 88.6 (53.7%) whereas the mean score of social sciences was 92.1 (55.8%) with a mean difference = 3.524.

#### 4.1.6. Interview and FGD results

##### 4.1.6.1. Efforts of MOE and EPA

Environmental education, historically, was initiated in 1985 as a pilot project in northern Ethiopia in collaboration with donors (SIDA) and state ministers (MOE, MOH, and MOA) (Beletu and Yosef 1990). As a result, conservation works such as tree planting; terraces construction and check-dams were undertaken. That is, it was pure conservation education project rather than integrating environmental issues in to the various school curricula so as to change the attitude and behavior of students.

However; the need for integrating environmental issues in the school curriculum were reaffirmed, after adopting the 1992 Earth summit at Brazil.

Following the endorsement, legal foundations by constitution of Ethiopian government (constitution, 1995), formulation and incorporating of general and specific objectives in the

policy document by MOE (1994), as well as the need for integrating EE in the formal curriculum by Environmental protection authority of Ethiopia (EPA 1997) were the achievements made so far. In their respective policy document, for instance, both MOE (1994) and EPA (1997) clearly do state.

“... Promote the teaching of EE on an interdisciplinary basis and integrate EE in to the ongoing curriculum of schools and colleges not treating as a separate or additional subject...” (EPA 1997:24)

“... Provide education that can produce citizens who possess national and international outlook on the environment, protect natural resources and historical heritages of the country...” (MOE 1994, article 2.2.14)

Despite such positive attempts and efforts together with smart objectives and goals, practically it seems discouraging as evidences on expected activities such as preparation of EE guidelines, pilot studies on the status of EE at various levels of schooling, awareness or sensitization workshops, establishing role models (at school, or community or institution levels) etc are not adequate enough as expressed, during interview, by higher education curriculum transformation and improvement unit of MOE and the EE department unit of EPA.

So, efforts to re-orient the existing education system toward building environmental literacy and sustainable development should be a fact to be considered collaboratively.

#### **4.1.6.2. Efforts by Universities: A case at BDU**

Creative teaching, timely research, updating and greening course materials, establishing role models in the campus and to the local communities for a burning issues such as environmental deterioration for the local region or for a country are some of the expected agenda that higher education institutions should give priority. However; in this respect, ‘BDU seem salient’ as interviews conducted with FOE dean, biology and geography department heads and some instructors expressed in relation to building environmental literacy for undergraduates.

Though there were no formal environmental literacy programs that reach across all graduates, no greening curricular materials toward environment and sustainability and no environmental forums per university, the usual traditional course breaking lists indicated that geography department incorporated courses such as environment and development, natural resource and geography for geographers and biology department incorporated courses such as ecology, conservation and biodiversity courses for biologists.

Probably, this may help to increase students' environmental awareness but the problem is that only students who were enrolled in geography and biology department had the opportunity to be formally informed.

Moreover; even some instructors themselves view environmental crisis doubtfully the root causes and remedial actions for environmental treats that our globe is facing. For instance, instructors whose names were kept anonymity for ethics purpose quoted below revealed the existing situation.

"...even I do not understand what environmental literacy means...." – chemistry instructor (M.Sc), a response for the question "how do address environmental issues to create environmentally literate graduates?"

"...EE is not delivered consciously and in a well integrated manner rather treated in a traditional way....." – Geography instructor (MA)

"...environmental issues seek more of political commitment and global consensus rather than institutionalizing ..." – biology instructor (MSc)

"... Political ideologies and scientific evidences seem conflicting from country to country..."

– Geography instructor (MA)

"...The environmental crisis is in part a crisis of concepts as well ..." – chemistry (MSc)

The above sample views seem to support David Orr's (1992) notion that environmental mismanagement is often the works of the highest educated people with BA/ BSc, LLB, MA/MSc and PhD.

In practice, observing "cooking food stuffs at students lounge using fire woods instead of environmentally friendly electricity , observing leaking water pipes and turned on light bulbs other than its intended functions , improper waste disposal at BDU " is the undeniable fact that the university lacks some sort of environmental literacy and this seem partly a contradiction to one of education and training policy stated in article 2.1.5 "cultivate the cognitive, creative productive and appreciative potential of citizens by appropriately relating education to the environmental resources and social needs."

Moreover; it seems sounding to undertake further studies about the environmental literacy of instructors and students in line with EE objectives since this study did not include instructors.

#### **4.1.6.3. Focus Group Discussion (FGD)**

FGDs' was conducted with biology (5 students, on April 7, 2008, at 1:00 to 1:20 pm, at Darfur building common name by students) and geography (8 students, on April 8, 2008, at 1:00 to 1:15 pm, block 3, dormitory 163) to share their personal observations, reflections and opinions about the trends, the likely causes, effects, remedial actions and responsible bodies in relation to national or global environmental problems. The environmental issues they raised vary from individual to individual. These were, indeed, expected as they were from different geographic zones and have different information access outlets. Moreover; they related the causes of environmental problems differently: "some to religious, some to industrialization, some to population explosion and still some to a combination of these."

More specifically, the following quotes reflect how group participants, whose names were kept anonymity, related the causes and sensitized environmental problems.

... "God put man in the garden to cultivate and care for the garden.".... Genesis 2:1/ biblical source mentioned by biology student

" The problems we have created in the world today will not be solved by the same level of thinking that created them." — acknowledging Albert Einstein mentioned by biology student

"... Climate change is the most severe problem that we are facing today -- more serious even than the threat of terrorism...." - geography student

".....I think that the relationship between humans and the environment is becoming worse and worse and we human beings are more susceptible to health risks, drought, and famine..."- geography student

*OC: Though it is difficult to generalize all the FGD participants sense or understand in the same manner equally, the above quoted ideas really indicate how they perceive and I was surprised with their hot debate.*

Moreover; lists of environmental problems which affect sustainable development, participants talk about during the discussion, includes:

*Destruction of the rainforest; endangered animals, plants, insects ; air pollution or smog ; not enough energy (such as electricity, oil, etc) ; pollution of lakes, rivers, streams ; acid rain, that is, air pollution that makes rain acidic, causing damage to lakes, buildings and forests ; damage to the ozone layer over the earth, permitting strong rays to get through, causing skin cancer and other problem; too little recycling ; global warming, that is, a build-up of certain gases in the atmosphere that will cause the temperature on earth to rise ; not enough landfill space for garbage and trash ; shortages of good drinking water ; littering of trash and garbage ; pollution of water from fertilizers and pesticides used in farming ; damage to the environment caused by mining or cutting down trees ; destruction or filling in or wetlands, that is, places where birds and fish breed etc.- transcribed from both group participants.*

The scientific idea and lists of environmental problems raised by participants implies that if students were assisted by formal environmental literacy programs, they would scale up their environmental knowledge, attitude and practical participation. However; in relation to 'who is responsible for the environmental problem(s) our country or world faced' seem inconclusive. Some said 'rich countries', some said 'the government', some said 'the population'.

Generally, it seems sounding to set environmental literacy programs in relation to EE objectives so that students will acquire appropriate knowledge about the environment, develop favorable attitude toward the environment and engage in environmental friendly activities.

#### ***4.2 Discussion of Findings***

Nowadays, humans are consuming more of the earth's natural resources than earth can regenerate (a situation called *ecological overshoot*), which is demonstrated by, amongst others, loss of forests, washing away of fertile soil, pollution (air, water and ground) and decreasing biodiversity, an issue category that is called environmental degradation (Aklilu,2001). Actions could be taken to go back to equilibrium and repair the damage that has been done. In order for anyone to take an action, one has to be aware of the necessity of the action to be taken. This awareness depends on an individual's attitude towards the environment. Data indicate that a good knowledge of environmental concepts is not sufficient; knowledge of environmental issues, issue skill analysis, and attitudes and values related to taking action are also necessary for the individual to take action and to act responsibly.

The theory of reasoned action, as well as the theory of planned behavior, proposes that attitude influences behavior, mediated by intention. Factual knowledge can be seen as a precondition of any attitude and, thus, the relationship between factual knowledge and behavior is mediated by intention as well. Moreover, subjective norms, or at least one's values, are also mediated by intention and therefore predict behavior indirectly.

Given these interrelations, this section tries to discuss the research findings in relation to the available literatures.

##### **4.2.1. Sources of Environmental information**

Mean value results of sources analysis (table 4.1) indicate that various school education systems are better contributors for the knowledge they have about the environment in general and the attitude (positive or negative) they developed followed by electronic media, printed

materials, self experience/age and the least their friends and parents. Their mean difference lies in between 0.11 and 0.36 inclusive. Indeed, the possibility of getting environmental information from various sources were also reflected during FGD held with biology and geography participants as the time itself is 'information age'

Supporting the influence of different source of information, Coyle (2005) noted that in the course of a lifetime, an individual will accumulate a varying degree of environmental knowledge and comprehension, develop sense of fleeing and take action about the components of the environment and their interactions from a combination of school service, media exposure, personal reading, family members and friends, outdoor activities, entertainment outlets, activist backgrounds, and a wide range of other professional and personal experiences. Hart (1979) also hypothesize that since EE by its nature is interdisciplinary (part of every subject taught) and multilevel (taught at all grade levels), students will expose to various sources of environmental information at different times in different places that influence their thoughts, feelings, and concerns and actions accordingly.

#### **4.2.2. Level of Environmental Knowledge, Attitude, practice and Environmental literacy index**

Results shown in table 4.2 revealed that respondents attitudes are highest followed by lower knowledge and lower behavioral practice relatively. A similar trend was also found in a study by Connel et al (1999), Scott and Willits (1994) and Kuhlemeier et al (1999).

However; analysis of item means and their subsequent percentile scores indicate that students have: very general and uncritical knowledge (item mean =2.1 or 52%), attitudes that cannot be rated as promising or talented (item mean =2.5 or 52.3%) and very poor environmentally friendly activities engagement (item mean =1.4 or 46.1% which can be rated as D grade on the basis of relaxed MOE grading scale) (Table 4.2).

Respondents failed to answer nearly half of the knowledge items. This may be due to lack of wider experience and basic understanding of environmental issues since environmental

knowledge (factual knowledge, issue based, skill based) stems from wider experience and basic understanding of environmental issues (Rao and Reddy, 200).

Similarly, results of environmental attitude show that respondents score slightly above the average position indicating that they fail to demonstrate strongly favorable attitude toward the environment. This may be due to the influence of environmental knowledge because salient information or factual *knowledge* is a necessary precondition for any attitude (Stutzman & Green, 1982).

Like the attitude, the mean score of behavioral practice falls in the rating scale between rarely and sometimes, indicating low frequent practical participation toward environmental protection and environmentally friendly activities engagement. This may be the consequence of low environmental knowledge and attitude though the direct influence of knowledge is attenuated both by environmental attitude and behavioral intention (figure 2.2).

Regarding this, Kaiser and et al (1999) do state that active participation stem from proper knowledge and attitude.

Overall, students have some degree of awareness (unsystematized factual knowledge) about environment, generally they seem to have a positive feeling toward the environment but they do not often practice positive actions concerning environmental friendly activities like environmental preservation, protection and conservation. Probably, this may be due to the absence of well integrated formal environmental literacy program in the University, absence of role model and propagation of unscientific information outlets as reflected during interviewing instructors and conducting FGD with some students.

#### **4.2.3. Environmental Literacy component correlation**

Research findings are highly controversial not only regarding environmental literacy components but also the variables or moderators that influence environmental literacy and its components .To appreciate the controversies, the study attempted to answer the question:

“What is the extent of the relationship of an individual’s score on the separate components of the environmental literacy survey (knowledge, attitude and practice/ behavior)?” in a sequential way to predict one another.

Table 4.12. Bivariate Correlation coefficient

|           |                     | Knowledge | Attitude | Practice | EL       |
|-----------|---------------------|-----------|----------|----------|----------|
| Knowledge | Pearson Correlation |           | .190(**) | .175(**) | .762(**) |
| Attitude  | Pearson Correlation | .190(**)  |          | .008     | .567(**) |
| Practice  | Pearson Correlation | .175(**)  | .008     |          | .599(**) |
| EL        | Pearson Correlation | .762(**)  | .567(**) | .599(**) |          |

\*\* Correlation is significant at the 0.01 level (2-tailed). N=302

#### 4.2.3.1. Knowledge vs Attitude

The calculated Pearson correlations were significant at  $\alpha = 0.01$  level (2-tailed-) and results indicate that there is a very weak correlation between knowledge and attitude ( $r = 0.190$ ) (figure 4.5, table 4.12).

Comparing correlation coefficients( $r$ ) and coefficient of determination ( $r^2$ ); for instance; knowledge vs attitude ( $r=.190$ ;  $r^2= 0.036 = 3.6\%$ ) suggests that 3.6% of the variation in the attitude may be considered as being associated with the variation in the knowledge. Putting it in another way; it means 96.4% of variation in attitude is due to factors other than knowledge; perhaps self-efficacy, moral values and locus of control.

As Kaiser et al (1999, p.4) remark "factual knowledge about the environment is a precondition of one's environmental attitude". This has an implication to say the lower the environmental knowledge, the lower the environmental attitude and hence low correlation. But to Alaimo and Doran (1980), increased knowledge alone will not significantly change attitudes and values.

Though, to Zimmerman (1996), the relationship between environmental knowledge and attitude is a complex one and not fully understood, the hypothesis knowledge and attitude had a weak to moderate relationship is supported in the literature.

For instance; In Kuhlemeier et al (1999) study of environmental literacy in Dutch ninth grade students, they found a weak correlation between knowledge and attitude. In Mangas and Martinez's (1997) study regarding university students enrolled in an elective environmental education course showed that students' environmental knowledge increased at the end of the course and was accompanied by an increase in an environmental attitude.

Similarly, Bradley et al (1999) study of environmental knowledge and attitude in high school students, they found that after an environmental science course, students had higher environmental knowledge and attitudes between the pre and post tests proportionally.

#### **4.2.3.2. Knowledge vs Behavioral practice**

Results indicate that there is a very weak correlation between knowledge vs behavioral practice ( $r=0.175$ ) but an insignificant relationship (figure 4.5, table 4.12).

Comparing correlation coefficients( $r$ ) and coefficient of determination ( $r^2$ ); for instance; knowledge vs behavioral practice ( $r=.175$ ;  $r^2= 0.031 =3.1\%$ ) suggests that 3.1% of the variation in the behavioral practice may be considered as being associated with the variation in the knowledge. Putting it in another way; it means 96.9% of variation in behavioral practice is due to factors other than knowledge; perhaps behavioral intention, situational factors and perceived behavioral control according to figure 2.2 and figure 2.3.

As indicated by the theoretical models of behavioral change (figure 2.2 & 2.3), knowledge and behavioral practice are not expected to have strong correlation. This study result supports Azjen's (1988) notion that knowledge is a precondition for behavioral practice though not included as a separate component in the model. Strengthening Azjen's notion, Kaiser et al (1999), remark that knowledge should not be related with behavioral practice strongly because its influence is attenuated both by environmental attitude and intention. They also explain the possibility of stronger relation, that is, when the relationship between knowledge and behavioral practice appears to be stronger, it is knowledge about ecological behavior rather than factual knowledge about the environment that is related to ecological behavior practice.

Similarly, Kuhlemeier et al (1999) study of environmental knowledge, attitudes, and behavior in ninth grades in Holland, they found a weak correlation ( $r=.20$ ).

Generally, behavioral practice and knowledge have been reported to have no or weak correlations. This is because the effect of knowledge is attenuated by attitudes, situational factors, behavioral intention and subjective norms (figure 2.1, 2.2 and 2.3). Hence; further research is needed including these factors.

#### **4.2.3.3. Attitude vs Behavioral practice**

The calculated correlation coefficients indicate that there is extremely low correlation between environmental attitude and behavioral practice ( $r = 0.008$ ). There was also an insignificant relationship between attitude and behavioral practice (table 4.5, table 4.12).

This result contradicts the hypothesis that attitude and behavior have a moderate to strong correlation in the literature. For instance, study results with different groups such as school children (Bradley et al ,1999), teachers (Hsu and Roth,1998) and the general population (Hines et al ,1986/87,Kaiser et al ,1999) support the moderate to strong relation.

Furthermore, Hines et al (1986/87) found that when the practical action is actually observed rather than self-reported, the attitude-behavioral practice correlation went up to  $r=.427$  that were moderate ( $r=.347$ ).

By contrast, other studies have assumed that self-reported behavioral practices are usually over-reported.

Moreover; Scott and Willits (1994), in their study of Pennsylvanians' environmental attitude and behavioral practice, found that attitudes were predictors of behavioral practice but the correlations were weak at  $r=.21$ .

Table 4.13 Linear regression results

| Variable  | Attitude |       | Behavioral practice |       | Environmental Literacy |       |
|-----------|----------|-------|---------------------|-------|------------------------|-------|
|           | $\beta$  | $R^2$ | $\beta$             | $R^2$ | $\beta$                | $R^2$ |
| Knowledge | .190     | .036  | .175                | .031  | .762                   | .581  |
| Attitude  |          |       | .008                | .000  | .567                   | .321  |
| Practice  |          |       |                     |       | .599                   | .359  |

Regression of respondents' environmental knowledge indicates that environmental knowledge was a significant positive predictor of attitude (standardized  $\beta = .190$ ,  $p < .01$ ), behavioral practice (standardized  $\beta = .175$ ,  $p < .01$ ), and environmental literacy (standardized  $\beta = .762$ ,  $p < .01$ ).

Thus, participants' environmental knowledge account for 3.6%, 3.1% and 5.8% of the variation of participants' attitude, behavioral practice and overall environmental literacy respectively.

Similarly, participants environmental attitude had significant positive predictive effect on their overall environmental literacy (standardized  $\beta = .567$ ,  $p > .05$ ).

Generally, the knowledge, attitude and behavioral nexus supports Davies's (1981) notion that they are not fully interdependent as unidimensionality or multidimensionality of the measuring instrument affects.

### **4.3 Effects of Moderators on Environmental Literacy and its components**

#### **4.3.1 Effects of age and class standing**

Analysis of age subpopulation using one way- ANOVA and independent-test revealed that there were a significant difference in environmental knowledge ( $F(1,300)= 9.14, p<.05$ ),  $T(300),=3.024, p<.05$  and environmental literacy index ( $F(1,300) =5.98, p<.05$ ),  $T(300), =32.446$  and  $p <.05$  (table 4.4 and 4.5), but an insignificant difference in environmental attitude and behavioral practice,  $p>.05$ . In most components, the older groups (>19 years of age) scored better but not in the behavioral practice (table 4.3)

In class standing analysis, the results were the same essentially for age subpopulation analysis. There was a significant difference in environmental knowledge ( $F(2,299) =16.76, p<.05$ ), behavioral practice ( $F(2,299) =3.19, p<.05$ ) and environmental literacy index ( $F(2,299) =6.79, p<.05$ ) (table 4.6).

In environmental knowledge and environmental literacy index, freshman had the lowest score followed by juniors and seniors. In both sections, seniors have the lowest score in behavioral practice and the highest in environmental literacy index (table 4.3). This trend was also observed in a study in high school students by Batterham et al(1996) cited in Aklilu(2006) that seniors or orders were better scorers in perception and abstract thinking about environmental problems.

By contrast, a review of the work of Osman and Parker(1987) and Gifford et al,1982) by Aklilu(2006) indicated that no correlation between age and any of the dependent variable when respondents moved from first to fourth year of college education.

In summary, this trend cannot be adequately explained on the basis of this study. However; it seems that since seniors, also older in age, have in every category the highest score in overall environmental literacy, indicating that there is some increase in environmental literacy while staying in University. It is not possible to say .however; whether this general trend of increased environmental literacy is as a result of taking science courses or simply growing older and more responsible or increased exposure to environmental issues through media sources such television, news papers and magazines.

Further research is necessary to understand how environmental literacy and its components interact in realty, particularly, in relation to age and year level so that an effective course of action can be established for environmental literacy program.

#### **4.3.2. Effects of Gender**

Analysis of gender subpopulation using ANOVA (table 4.7) and independent t-test (table 4.8 ), revealed that there was a significant difference in over all environmental literacy index (( $F(1,300)=4.308, p<.05$ ),  $T(300), =2.076, p<.05$  but an insignificant difference in environmental knowledge, environmental attitude, and behavioral practice (table 4.6)  $p>.05$  .This is in support of Hsu and Roth (1996) who found no significance difference in environmental knowledge but in contradiction to a study by Roth and Perez (1989) cited in Aklilu (2006) that disclosed students' knowledge and attitude were significantly related to sex, with males consistently outscoring females. Others were also found and hypothesized as females had a higher attitude score than males, while males had a significantly higher cognitive score (Hausbeck et al, 1992, Gifford et al, 1982, cited in Aklilu ,2006).

The mixed support for gender and environmental outcomes may be due to the fact that one's environmental attitudes and behavior may have less to do being female or male ( being a member of social category ) and more to do with the meanings that people attribute to themselves as masculine or feminine(their gender identity).

While masculinity is *agency focused* - emphasizing competition and interdependence, femininity is *communion oriented* –highlighting sensitivity and a concern for others (Eagly, 1987).

The explanation that has received the most consistent support as to why women express high levels of environmental concern is that women *care more* about the health and safety of their families and communities than men do ((Davidson and Freudenburg ,1996). Caring is believed to be an orientation that women adopt than do men (Cancian and Oliner, 2000).

Further research should be undertaken if the roles that women occupy in the society, such as domestic worker, and primary caretaker, have a direct effect for environmental concern since the effect of gender in this study did not support though Ethiopian women's seem to act as domestic worker, and primary caretaker.

#### 4.3.3. Effects of academic stream

Analysis of stream subpopulation using ANOVA (table 4.10) and independent t-test (table 4.11 ), revealed that there was a significant difference in environmental knowledge ( $F(1,300)=4.308, p<.05$ ),  $T(3.97), df =300, p<.05$  but an insignificant difference in over all environmental literacy index ( $F(1,300)=4.308, p=.05$ ) in environmental attitude, and behavioral practice (table 4.10 and 11). A similar result was also found analyzing by department. That is, Geography respondents' score was better in environmental knowledge and environmental literacy than biology or chemistry. Probably, the environmental issues included in ELS instrument may be more treated in the geography curriculum at various levels of schooling and hence social science students had better exposure and factual knowledge. Further research including curriculum materials is needed.

By contrast, though the researcher failed to find adequate other research reports, one study by Gifford et al (1982) cited in Aklilu (2006) revealed that natural sciences were known to have better knowledge while social sciences had better emotion about the environment which is in contrary to the current study result.

#### 4.3.4. Effects of growing area

Mean values of table 4.10 indicated that respondents with rural backgrounds scored better than respondents with urban background in environmental literacy and in all of its components but analysis of growing area using one way ANOVA (table 4.9) revealed that there were insignificant differences in all of subsections. A similar result was also found in study on ninth and tenth graders of secondary school by Asmare (200). In a country where 85% of the population is believed to be rural, and no clear demarcation among rural, suburban and urban division, this result may not be surprising.

By contrast, in Hausbeck et al (1992) study, they found that students growing up in the city do not only lower knowledge but also were less concerned about the environment when compared to students growing up in suburban and rural areas .The disparity was explained in terms of rural students' proximity to and greater interaction with the environment.

Generally, the effects of growing area seem to be inconsistent; as a result, there is a room for further research.

In summary, the effects of moderators on environmental literacy and its components' found to be inconclusive. Hence, further research is necessary to understand how the various components of environmental literacy interact in reality, particularly using different moderators or variables, so that an effective course of action can be established for environmental literacy program in Ethiopian context

## *Chapter-Five: Summary, Conclusions and Recommendations*

### *5.1. Summary*

Environmental problems are frequently complex either due to uncertain scientific evidence or conflicting interests due to economic, aesthetic and ethical considerations. As a result, no country can remain immune or free from environmental problems, though there is a variation in nature, magnitude and complexity of the problems.

Developing countries like Ethiopia are frequently experiencing environmental problems associated with underdevelopment-unsystematic farming leading to soil erosion, improper management of forest resources, poor health and nutrition, vulnerability to natural disasters and the lack of education programs that help to solve these problems to mention a few.

Responding wisely to such environmental challenges Ethiopia is facing in the 21<sup>st</sup> century will require collaboration among experts in many fields: elected officials, government staff, environmental advocates, business leaders, scientists, educators, lawyers, consultants, architects, religious leaders and many other professionals. It also hinges on the thoughtfulness and responsibility of ordinary citizens in their roles as producers, consumers, parents, voters, and volunteers.

If environmental problems are to be addressed in a sensible way, a fundamental starting point must be a sound understanding of school curricula and socioeconomic systems and the likely consequences of our actions. Citizens who are knowledgeable about environmental issues will often make more appropriate personal and professional choices. In contrast, poorly informed and unengaged individuals will be more likely to make less-appropriate choices, such as supporting the wasteful use of natural resources.

In light of this, setting specialized environmental education program, that lead to creation of an environmentally literate citizenry, in universities is undoubtedly fully very important as Universities (1) are central figures to implement policy issues and strategies (2) equip young

people with the tools necessary to be successful after they leave, and (3) develop a world population that is aware of, and concerned about, the environment and its associated problems.

Environmental literacy (EL), goal of environmental education, is used to describe an individual's capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore or improve the health of those systems.

As a result, an individual who is environmentally literate is expected to possess the following characteristics: (1) environmental knowledge ;( 2) environmental attitude and sensitivity; (3) problem solving, planning and collaborative/facilitative skills, action strategies, and (4) the ability to take action to improve the environment.

Thus, the main objective of this study was to examine the levels and relationships of environmental literacy (EL) and its components- knowledge, attitude and behavioral practice- in undergraduate university students, and to analyze differences in scores on components of environmental literacy by gender, academic stream, growing area, class standing or year levels and age sub populations.

In order to achieve the objectives, the following guiding questions were formulated.

1. What source of information contributed to what they know about environmental issues and problems?
2. How low or high are undergraduate University students' environmental knowledge, attitude and behavioral practice against MOE/GEQAEA grading scales?
3. What is the extent of the relationship of an individual's score on the separate components of the environmental literacy survey (knowledge/cognitive, attitude/affective and practice/behavior)?

4. Will there be a significant difference in subpopulations (male/female, rural/urban, class standing, age, and natural science/social science) scores on the three components and the total score?

In view of the above objectives, a descriptive survey methodology was employed. BDU undergraduate regular education students, particularly biology, chemistry and geography students ranging from first year to third year in the academic year 2007/08 were the main source of data. Before collecting actual data, pilot study was done by the researcher so that the instrument was refined and tested for reliability. Questionnaire and FGD were the main data gathering tools from students. Three departments were selected purposefully while sample size was determined on the basis of sample size formula for research activities (Appendix I). As a result, 302 respondents were selected from the three departments (that is, from 1395 students, 118 geography, 99 biology and 85 chemistry, total =302 participants) using proportional stratified sampling technique taking department as stratum.

To analyze data, both descriptive (percentile, mean, standard deviation) and inferential (simple correlation, independent T-test, one way ANOVA) statistics methods were employed on the basis of their theoretical assumptions.

**As a result of data analyses and discussions, the student –researcher identified the following major findings.**

1. Formal education system at various levels followed by electronic media were the greatest contributors in helping undergraduates to know about ecological concepts, environmental issues and the attitudes they have developed toward environments in general.
2. Grades on the basis of relaxed MOE scale (knowledge: C; attitude: C; behavioral practice: D and environmental literacy index: C) suggest that undergraduates at BDU have a moderately favorable environmental attitude (62.3%) followed by nearly moderate environmental knowledge (52.4%) but below average in environmentally friendly practices

engagement (46.1%). It is worth noting that since the behavioral practices were self-reported rather than actually observed, actual practices are probably lower, perhaps much lower.

3. The multi-collinearity relationships of environmental knowledge, attitude and behavioral practice found to be very weak (that is, knowledge vs attitude,  $r = .19$ ; attitude vs behavioral practice,  $r = .008$  ; and knowledge vs behavioral practice,  $r = .175$ ). This may be due to homogeneity of respondents and/ or absence of formal environmental literacy program that enhances students' literacy.

4. Results of age analysis and class standing or year level suggest that older students who are also seniors or third years followed by juniors or second years had higher scores in environmental knowledge, attitude, behavioral practice and overall environmental literacy. This indicates that there may be some type of intrinsic increase in environmental literacy as time spent at university increases.

5. In overall environmental literacy respondents who are males, with rural background and social science streams had higher scores than the corresponding females, with rural backgrounds and natural sciences. However; the effects gender, academic stream and growing area, in relation to available literature reports and this study results are inconclusive on separate components (knowledge, attitude and behavioral practice) as an insignificant difference were observed.

6. BDU lacks launching environmental literacy program that reach across graduates before leaving the university and there seem a loose link between BDU, MOE and EPA in greening or re-orienting the existing curriculum toward environmental literacy as a core requirement for sustainability.

## 5.2. Conclusions

The essence of environmental literacy lies in the questions we learn to ask about our world and our relationships with it; in the ways we respond to such questions, the ways we seek and find answers to those questions; and the ways we use the answers we have found.

**Based on the findings of the study, the following conclusions were drawn.**

1. Different sources preferably formal education followed by informal channels have helped undergraduates for the factual knowledge they acquired about environment and the favorable attitudes they have developed in the environment in general.
2. The levels of undergraduate students over all environmental literacy, at BDU, are satisfactory from the non-formal environmental literacy point of view. But results of the separate component revealed that they are poor particularly in 'practical action' which is a distinguishing characteristic of environmental literacy.
3. The correlations among environmental literacy components (knowledge vs attitude, attitude vs behavioral practice and knowledge vs behavioral practice) are very low ( $r < 0.2$ ).
4. Building on existing tendencies for environmental literacy to increase more, as was demonstrated by the class standing and age subpopulation, will allow students to engage deliberately in responsible environmental behaviors. Moreover; further research is needed to test whether the difference is due to a university effect or to some other unexplainable variable.
5. The effects of moderators, in particular gender, academic stream and growing area, in relation to available literature reports and this study results are inconclusive on separate components of environmental literacy (knowledge, attitude and behavioral practice). Hence, there is a room for further research to be undertaken for the variables gender, academic stream and growing area in Ethiopian context.

6. Formal environmental literacy program has not yet established either by BDU initiative or in collaboration with MOE, EPA or other environmental organization(s).

### **5.3. Recommendations**

On the basis of the findings, discussions and conclusions made so far the following recommendations hoped to alleviate the existing gap (problem) are forwarded.

#### **1. Policy and strategy implications**

1.1. Policy documents of MOE and EPA address well the environment. However; the technical supports or efforts made in collaboration with BDU to establish environmental literacy program appear to be inadequate. Hence MOE, EPA and BDU should be active participants to integrate EE in university curricula so that the younger generation will be well informed with appropriate environmental knowledge, attitude and behavioral action before leaving the university.

1.2. The possibility of integrating EE in different courses needs preparation of some 'guide lines' in line with the objectives of EE and sensitizing them. In this respect either MOE or universities should take the responsibility and organize a re-orientation program through various forms (workshops, seminars, staff meetings etc) and embark on the journey to 'green or environmentalize their curricula.'

1.3 Setting environmental literacy program aimed to produce more resource materials related with courses, give accurate and up-to-date information regarding environmental issues for instructors and students should be a fact to be considered in universities. It is also essential to have environmental forums to debate on environmental issues and celebrate 'Earth day' at university level.

1.4 It seems essential to be role model in encouraging and supporting students during their training program to participate in environmental clubs devoted to the conservation, protection,

wise use of resources and appreciation of the environment as it enhances their attitudes and values.

## **2. Further Research implications**

The results of this study suggest several implications for further research regarding environmental literacy of undergraduate university students.

2.1. Regarding the correlations between the components of environmental literacy, it would be interesting to study whether the correlations between knowledge and other components increase based on a directed environmental literacy effort at a university with an established environmental literacy program.

2.2. Since the bivariate coefficient of attitude vs practice is much lower, further study should be undertaken to analyze whether or not the impact of subjective norms, behavioral intention and situational factors really reduce in line with TPB or TRA.

2.3. As more university environmental literacy programs appear, there is a need to develop valid, reliable and inclusive environmental literacy measuring instrument in Ethiopian context.

2.4. Since this study involved the use of a survey instrument with self-reported behavioral practices, further studies could be conducted using direct observation and interview methods for determining an individual student's environmental literacy.

2.5. Regarding the progression indicated in all sections from freshman to seniors and also between under 20 and over 19 age groups, a longitudinal study (a specific group of undergraduates vs another group of non undergraduate young students) over three year time is preferable to distinguish if the increase in environmental literacy is due to aging or university experience or both.

2.6. Finally, the student-researcher feels that the issue of EL in Ethiopian context has not been researched adequately. Basically, the evidences seem to be that there is little available data on the topic. Therefore; more research with large samples, reliable instruments, appropriate and rigorous statistical procedures seem to be vital.

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# APPENDICES

## Appendix –A: Questionnaire

Addis Ababa University

School of Graduate studies

Institute of Educational Research

Questionnaire to be filled by Bahir Dar University students

The main objective of this questionnaire is to determine the level of University students' environmental literacy-knowledge attitude and practice or behavioral action .This survey is not a part of the regular curriculum for this class and participation or non participation will not affect your grade. The trustworthiness of the study is based up on the accuracy of the information you provide I assure you that your answers are completely confidential. If you have questions that are not clear you can ask at any time. **No need of writing your name.**

Thank you for your participation!

### *Part One: Personal and Demographic data*

Circle or write the one that best describe your personal profile

1. Age : a/below 20    b/ 20 and above

2. Sex:    a/ male    b/ female

3. Growing area:

A/rural farm - any rural village or woredal town in Ethiopia

B/sub urban - any zonal town in Ethiopia

C/urban/city center- A.A, Awassa, Bahir Dar, Mekelle, Adama, Diredawa,

4. Year level: a/ I    b/II    c/III d/IV

5. Department \_\_\_\_\_

## Environmental literacy survey (ELS)

*Instruction: Please answer the questions trustfully and to the best of your ability. There is only one answer for each question asked. There are four sections in the survey (source of environmental issue information, knowledge, attitude and practical action sub sections).*

*Each section is different so please read the directions carefully before starting each section.*

### Part two. Source of Environmental issues information

Thick the following possible sources of information to what degree theses different sources help you to know more about environmental issues and problems using the following key.

1= not at all, 2 = a little, 3 = quite a bit, 4 = very much

| N0 | Sources of information  | 1 | 2 | 3 | 4 |
|----|---|---|---|---|---|
| 1  | various school education system (primary, secondary and higher education) |   |   |   |   |
| 2  | Electronic media(TV, radio etc)   |   |   |   |   |
| 3  | Printed materials' ( books, news paper, magazines etc)                    |   |   |   |   |
| 4  | parents and friends   |   |   |   |   |
| 5  | age/self experience   |   |   |   |   |

### Part Three. Environmental knowledge

*This section of the survey is designed to determine knowledge about environmental issues. Please CIRCLE the letter that reflects what you think is a correct response to the statement or question. This is not a test! Don't worry, if you can't answer many of these.*

*If you don't know the answer, guess.*

1. There are many different types of animals and plants, and they live in many different environments. What word is used to describe this idea? types of

a/ biomagnifications   b/ biodiversity   c/ habitat isolation   d/ community

2. Most electricity in Ethiopia is generated from which source of energy?

a/ geothermal b/ solar radiation c/ burning coal d/ hydro power

3. The most serious environmental problem in Ethiopia is:

a/ land degradation b/ air pollution c/ population growth d/ water pollution

4. At present less than 3% of the land is estimated to be covered by forests in Ethiopia. Which part of Ethiopia represents this forest coverage? a/ Northern high land b/ Semen and Dali mountains c/ South west Ethiopia d/ Central and Eastern part of the country

5. All of the following are the possible consequence Global warming except?

a/ rising sea levels due to the melting of ice caps

b/ failing agricultural productivity c/ less of biodiversity d/ lowering super storms

6. Which one of the following acts as a shield against the damaging ultra-violet radiation

of the sun in the upper atmosphere? a/ nitrogen b/ oxygen c/ ozone d/ CFCs

7. A food web consists of : a/ animals that eat other animals in a community b/ herbivores and carnivores in an ecosystem c/ many interconnected food chains d/ consumers in an ecosystem

8. Which action can have the greatest impact on reducing the threat of global warming?

a/ recycling b/ reducing energy use c/ composting d/ planting a tree

9. Which form of household heating is generally considered most environmentally friendly?

a/ electric baseboard b/ coal c/ wood d/ natural gas

10. "Things have always being change. Evolution is all about survival of the fittest, and some things must disappear. We humans are not the fittest and strongest and we have the right to use the world resource for our benefit. We need the space and we have to change environments. If some plants and animals suffer hard luck"

This quotation reflects

a/ self-centered view b/ environmentalists' view c/ conservationist view d/ politician's view

11. Which one of the following contributes the least for environmental pollution?

a/ Transportation b/ industrial wastes c/ improper household waste disposal

d/ using non-toxic, phosphate-free, biodegradable soaps and detergents.

12. The effect of rapid population growth in rural areas on the environment is:

a/ urbanization b/ overgrazing and overcutting of woods c/ indoor and outdoor air pollution

d/terracing

13. Some insecticides that were once effective in killing insects no longer well effective. This is because 1/ new insect species develop every day 2/the wrong kind of insecticides were used

3/insects with natural resistance survived and multiplied 4/ the insects produced many more off springs than the insecticide could kill

14. Who is responsible for the environmental problem(s) that Ethiopia faces today?

a/ rich countries b/ environmental experts c/the government d\ every citizen

#### Part Four: Environmental Attitudes

*This part of the survey is designed to determine environmental attitudes. Please indicate how you feel about each statement below. There are no right or wrong answers, only differences of opinion. Read each statement carefully. Thick the column that best indicates the extent to which you agree or disagree with each statement using the following key*

*SA = strongly agree, A = agree, U = Undecided, D= disagree, SD = strongly disagree*

| no | Item   | SA | A | U | D | SD |
|----|--|----|---|---|---|----|
| 15 | The world's population is approaching the limit the Earth can support                        |    |   |   |   |    |
| 16 | Humans have the right to modify the natural environment to suit their needs.                 |    |   |   |   |    |
| 17 | When humans interfere with nature it often produces disastrous consequences.                 |    |   |   |   |    |
| 18 | Science and technology can overcome any environmental problem                                |    |   |   |   |    |
| 19 | Humans are severely abusing the environment  |    |   |   |   |    |
| 20 | The Earth has plenty of natural resources if we just learn how to develop them               |    |   |   |   |    |
| 21 | Plants and animals have as much right as humans to exist                                     |    |   |   |   |    |
| 22 | The balance of nature is strong enough to cope with the impacts of modern industrial nations |    |   |   |   |    |
| 23 | The Earth has very limited room and resources  |    |   |   |   |    |

|    |  |  |  |  |  |  |
|----|--|--|--|--|--|--|
| 24 | Humans were meant to rule over the rest of nature  |  |  |  |  |  |
| 25 | If things continue on their present course, we will soon experience a major ecological catastrophe   |  |  |  |  |  |
| 26 | I think each of us can make a significant contribution to environmental protection   |  |  |  |  |  |
| 27 | I am willing to have environmental problems solved even if this means sacrificing many goods   |  |  |  |  |  |
| 28 | Threats to the environment are not my business or concern  |  |  |  |  |  |
| 29 | I believe that environmental illiteracy is the main cause of environmental problem(s)  |  |  |  |  |  |
| 30 | I believe that the government of Ethiopia should not give license for industry owners if their plants have serious impact on our environment |  |  |  |  |  |

**Part five. Environmental Behaviors or Practical Action**

*For the following group of statements, please indicate how frequently you do each of the actions mentioned. Be honest, there are no right or wrong answers, so don't worry if you have never done any of these activities, and don't worry if all your tick marks end up in the 'N' column. I ask only that you be truthful as you answer these questions.*

Mark the answer that is closest to the right answer for you using the following key:

**N** - stands for never or no

**R** - stands for rarely (three or four times a year)

**S** - stands for sometimes (three or four times a month)

**U** - stands for usually (most of the time you have the chance)

| No | Items   | N | R | S | U |
|----|---|---|---|---|---|
| 31 | I talk to people that I notice doing something that harms the environment in an effort to stop that person's activity (for example, try to burn or bury wastes instead of dumping to the environment) |   |   |   |   |
| 32 | I keep papers which are printed or written on one side in order to write on the other side  |   |   |   |   |
| 33 | I do visit parks and zoos in accessible areas   |   |   |   |   |
| 34 | I turn off light in rooms which are not being used to save electricity  |   |   |   |   |
| 35 | I plant trees or flowers on a yearly bases  |   |   |   |   |
| 36 | I talk with friends about problems related to the environment   |   |   |   |   |

|    |  |  |  |  |  |
|----|--|--|--|--|--|
|    |  |  |  |  |  |
| 37 | In the past, I pointed out to someone his/ her unfriendly environmental behavior   |  |  |  |  |
| 38 | For shopping, I prefer paper bags to plastic ones  |  |  |  |  |
| 39 | I am willing to take part in digging waste disposal pits   |  |  |  |  |
| 40 | I talk with families about land degradation and its consequences   |  |  |  |  |
| 41 | Being a member of an environmental organization, I contribute money  |  |  |  |  |
| 42 | I make a point of reading newspaper and magazine articles or watch TV about the environment                                    |  |  |  |  |
| 43 | I talk to my family and friends about what they can do to help solve environmental problems                                    |  |  |  |  |
| 44 | I purchase one product over another product because it is packed in reusable, returnable or recyclable containers or packages  |  |  |  |  |
| 45 | I keep away bottles, glasses, paper, plastic, dead batteries and / or metal wastes in to areas of out of the reach of children |  |  |  |  |

*Thank you again!*

## Appendix- B: Pilot test

Addis Ababa University

Institute of Educational Research

School of Graduate studies

Questionnaire to be filled by Bahir Dar University students

Environmental literacy survey (ELS): pilot study

Hello! I am Taye Alamirew (*E-mail:taye99ier@yahoo.com*) and I am a Graduate student in the Institute of Educational Research at Addis Ababa University. The purpose of this questionnaire is to collect data about students' environmental literacy-knowledge; attitude and practice or practical action. I assure you that your answers are completely confidential. This survey is not a part of the regular curriculum for this class and participation or non participation will not affect your grade. If you have questions that are not clear you can ask at any time. No need of writing your name.

Thank you for your participation!

*Part I: personal and demographic data*

Circle or write the one that best describe your personal profile

1. Age : a/16- 20 b/ 21-25 c/ 26- 30 d/above 30

2. Sex: a/ male b/ female

3. Growing area:

A/rural farm - any rural village or woredal town in Ethiopia

B/sub urban - any zonal town in Ethiopia

C/urban/city center- A.A, Awassa, BahirDar, Mekelle, Adama, Diredawa

4. Year level: a/ I b/II c/III d/ IV

5. Department \_\_\_\_\_

Environmental literacy survey (ELS)

**Instruction:** Please answer the questions trustfully and to the best of your ability. There is only one answer for each question asked. There are three sections in the survey (knowledge, attitude and practical action components). Each section is different so please read the directions carefully before starting each section.

**Part II. Environmental knowledge**

*This section of the survey is designed to determine knowledge about environmental issues. Please CIRCLE the letter that reflects what you think is a correct response to the statement or question. This is not a test! Don't worry, if you can't answer many of these. If you don't know the answer, guess.*

1. There are many different types of animals and plants, and they live in many different types of environments. What word is used to describe this idea?

a/ biomagnifications   b/ biodiversity   c/ habitat isolation   d/ community

2. The major cause of pollution of streams, rivers and oceans in urban areas is:

a/dumping of garbage by cities   b/ surface water running off yards, city streets, paved lots, and farm fields   c / trash washed into the ocean from beaches   d / waste dumped by factories

3. Most electricity in Ethiopia is generated from which source of energy?   a/ geothermal   b/ solar radiation   c/ burning coal   d/ hydro power

4. The most serious environmental problem of Ethiopia is :   a/ water pollution   b/ air pollution   c/population growth   d/land degradation

5. What is the estimated percentage of land covered by forests in Ethiopia at present?

a/ 40%   b/ less than 3%   c/ 10%   d/ 20%

6. All of the following are the possible consequence Global warming except?

a/ rising sea levels due to the melting of ice caps   b/ failing agricultural productivity

/ loss of biodiversity   d/ lowering super storms

7. Which one of the following acts as a shield against the damaging ultra-violet radiation

of the sun in upper atmosphere?   a/nitrogen   b/ oxygen   c/ozone   d/ CFCs

8. A food web consists of   a/ animals that eat other animals in a community

b/ herbivores and carnivores in an ecosystem   c/ many interconnected food chains

d/ consumers in an ecosystem

9. All of the following are the social impact of land degradation in Ethiopia except:

- a/ food insecurity
- b/ migration
- c/ conflict among communities over shared resources
- d/ demineralization

10. Which one of the following is **not true** about acid rain?

- a/ it is caused by oxides of carbon, nitrogen, sulfur
- b/ it can damage non-replaceable buildings, statues, and sculptures
- c/ it affects breathing and lung problems in children and adults who have asthma
- d/ it facilitates fishes breathing system

11. Which action can have the greatest impact on reducing the threat of global warming?

- a/ recycling
- b/ reducing energy use
- c/ composting
- d/ planting a tree

12. Which form of household heating is generally considered most environmentally friendly?

- a/ electric baseboard
- b/ coal
- c/ wood
- d/ natural gas

13. *"Things have always been changed. Evolution is all about survival of the fittest, and some things must disappear. We humans are now the fittest and strongest and we have the right to use the world resource for our benefit. We need the space and we have to change environments. If some plants and animals suffer hard luck."*

This quotation reflects

- a/ self-centered view
- b/ environmentalists' view
- c/ conservationist view
- d/ politician's view

14. Which of the following is **not a serious** problem in developing countries?

- a/ industrial pollution
- b/ deforestation
- c/ unemployment
- d/ poverty

15. Which one of the following contributes the least for environmental pollution?

- a/ Transportation
- b/ industrial wastes
- c/ improper household waste disposal
- d/ using non-toxic, phosphate-free, biodegradable soaps and detergents.

16. The effect of rapid population growth in rural areas on the environment is a/ urbanization b/ overgrazing and overcutting of woods c/ indoor and outdoor air pollution d/ resource conservation

17. Who is responsible for the environmental problem(s) that Ethiopia faces today?

- a/ rich countries
- b/ environmental experts
- c/ the government
- d/ every citizen

18. Some insecticides that were once effective in killing insects no longer well effective. This is because 1/ new insect species develop every day 2/the wrong kind of insecticides were used

3/insects with natural resistance survived and multiplied

4/ the insects produced many more off springs than the insecticide could kill

**Part Three: Environmental Attitudes**

*This part of the survey is designed to determine environmental attitudes. Please indicate how you feel about each statement below. There are no right or wrong answers, only differences of opinion. Read each statement carefully. Thick the column that best indicates the extent to which you agree or disagree with each statement using the following key*

*SA = strongly agree, A =agree, U = Undecided, D= disagree, SD = strongly disagree*

| no | Item   | SA | A | U | D | SD |
|----|--|----|---|---|---|----|
| 19 | The world's population is approaching the limit the Earth can support                              |    |   |   |   |    |
| 20 | Humans have the right to modify the natural environment to suit their needs.                       |    |   |   |   |    |
| 21 | When humans interfere with nature it often produces disastrous consequences.                       |    |   |   |   |    |
| 22 | Science and technology can overcome any environmental problem                                      |    |   |   |   |    |
| 23 | Humans are severely abusing the environment  |    |   |   |   |    |
| 24 | The Earth has plenty of natural resources if we just learn how to develop them                     |    |   |   |   |    |
| 25 | Plants and animals have as much right as humans to exist   |    |   |   |   |    |
| 26 | The balance of nature is strong enough to cope with the impacts of modern industrial nations       |    |   |   |   |    |
| 27 | The Earth has very limited room and resources  |    |   |   |   |    |
| 28 | Humans were meant to rule over the rest of nature  |    |   |   |   |    |
| 29 | The balance of nature is very delicate and easily upset  |    |   |   |   |    |
| 30 | If things continue on their present course, we will soon experience a major ecological catastrophe |    |   |   |   |    |
| 31 | I think each of us can make a significant contribution to environmental protection                 |    |   |   |   |    |
| 32 | i am willing to have environmental problems solved even if this means sacrificing many goods       |    |   |   |   |    |
| 33 | People worry too much about environmental problems   |    |   |   |   |    |
| 34 | Threats to the environment are not my business   |    |   |   |   |    |
| 35 | I believe that environmental illiteracy is the main cause of environmental problem(s)              |    |   |   |   |    |

|    |  |  |  |  |  |  |
|----|--|--|--|--|--|--|
| 36 | I believe that the government of Ethiopia should not give license for industry owners if their plants have serious impact on our environment |  |  |  |  |  |
|----|--|--|--|--|--|--|

**Part IV. Environmental behaviors or practical action**

For the following group of statements, please indicate how frequently you do each of the actions mentioned. Be honest, there are no right or wrong answers, so don't worry if you have never done any of these activities, and don't worry if all your tick marks end up in the 'N' column. I ask only that you be truthful as you answer these questions.

Mark the answer that is closest to the right answer for you:

**N** - stands for never or no

**R** - stands for rarely (three or four times a year)

**S** - stands for sometimes (three or four times a month)

**U** - stands for usually (most of the time you have the chance)

| No | Items   | N | R | S | U |
|----|---|---|---|---|---|
| 37 | I talk to people that I notice doing something that harms the environment in an effort to stop that person's activity (for example, try to burn or bury wastes instead of dumping to the environment) |   |   |   |   |
| 38 | I keep papers which are printed or written on one side in order to write on the other side  |   |   |   |   |
| 39 | I do visit parks and zoos   |   |   |   |   |
| 40 | I turn off light in rooms which are not being used to conserve electricity  |   |   |   |   |
| 41 | I plant trees or flowers on a yearly bases  |   |   |   |   |
| 42 | I talk with friends about problems related to the environment   |   |   |   |   |
| 43 | In the past, I pointed out to someone his/ her unfriendly environmental behavior  |   |   |   |   |
| 44 | For shopping, I prefer paper bags to plastic ones   |   |   |   |   |
| 45 | I am willing to take part in digging waste disposal pits  |   |   |   |   |
| 46 | I talk with families about land degradation and its consequences  |   |   |   |   |
| 47 | I bring back unused medicine to the pharmacy  |   |   |   |   |
| 48 | I am a member of and contribute money to an environmental organization  |   |   |   |   |
| 49 | I make a point of reading newspaper and magazine articles or watch TV about the environment   |   |   |   |   |

|    |   |  |  |  |  |
|----|---|--|--|--|--|
| 50 | I talk to my family and friends about what they can do to help solve environmental problems                                   |  |  |  |  |
| 51 | I purchase one product over another product because it is packed in reusable, returnable or recyclable containers or packages |  |  |  |  |
| 52 | I support candidates for political offices who are concerned about environmental problems and issues                          |  |  |  |  |
| 53 | I keep away bottles, glasses, paper, plastic, dead batteries and / or metal wastes in to areas of out of children             |  |  |  |  |

**Part V. Source of information**

54. Rank the following possible sources of information from the **highest to the lowest (1<sup>st</sup> to 5<sup>th</sup>)** in helping you to know more about environmental issues and problems

\_\_\_ various school education system

\_\_\_ TV and radio

\_\_\_ News paper and magazines

\_\_\_ parents and friends

\_\_\_ age/self experience

## Appendix-C

### Expert Opinion

Hello. I am Taye Alamirew and I am a Graduate student, department of Educational Research and Development, in the Institute of Educational Research, Addis Ababa University.

I am conducting my thesis on environmental literacy.

The purpose of the study is to examine the relationships between the major components of environmental literacy (EL) - knowledge, attitude and self reported behavioral action toward sustainable development in undergraduate University students, and to analyze differences in scores on components of environmental literacy by gender, academic stream, residence back ground area, and class standing sub populations.

Dear colleague, I need your professional assistance to comment on construction, relevance and appropriateness of each items ,which are prepared for pilot study, based on your professional experience/ knowledge and to rate each items into highly (3), moderately (2) and poorly (1) according to the topic under investigation

*Instruction for the expert: please mark to what extent does the item measure the category it belongs using: 3=highly, 2= moderately or 1= poorly, and comment for modification*

*Thank you!*

*Cognitive/knowledge category (partly adapted from Melkamu, 1994, Coyle, 2005, Damtew,2007, and Asmare,2007)*

*For each of the following questions, choose the best answer and circle the number corresponding to your answer on your answer sheet.*

\_\_\_\_\_1. Young people learn about a lot of topics in school. Thinking about all of your classes, how much would you say you are learning about environmental issues in school at different levels?      1/a lot    2/ a fair amount  
3/ only a little    4/ practically nothing

\_\_\_\_\_2. There are many different types of animals and plants, and they live in many different types of environments. What word is used to describe this idea?

1/ multiplicity    2/ Biodiversity    3/ socio-economics    4/ Evolution

\_\_\_\_\_ 3. The most common major cause of pollution of streams, rivers and oceans is:

1/dumping of garbage by cities 2/ surface water running off yards, city streets, paved lots, and farm fields 3 / trash washed into the ocean from beaches 4 / waste dumped by factories

\_\_\_\_\_ 4. Most electricity in the Ethiopia is generated from what source of power?

1/ nuclear reactor 2/ solar energy 3/ burning coal 4/ hydro power

\_\_\_\_\_ 5. The most serious environmental problem of Ethiopia is

1/ water pollution 2/ air pollution 3/population growth 4/land degradation

\_\_\_\_\_ 6. At present, the estimated percentage of land covered by forests ,which were 40 - 60% hundred years ago, in Ethiopia is 1/ 60% 2/ less than 3% 3/ 10% 4/ 15%

\_\_\_\_\_ 7. Which one is the possible consequence of climate change resulting from Global

warming? 1/ rising sea levels due to the melting of ice caps

2/ failing agricultural productivity 3/ loss of biodiversity 4/ all of these

\_\_\_\_\_ 8. Which one of the following acts as a shield against the damaging ultra-violet radiation

of the sun in upper atmosphere? 1/ methane 2/ carbon dioxide 3/ Ozone 4/ CFCs

\_\_\_\_\_ 9. The social impact of land degradation in Ethiopia is

1/ food insecurity/poverty 2/ migration 3/ conflict among communities over shared resources 4/ all

\_\_\_\_\_ 10. Which one of the following is not true about acid rain?

1/ it is caused by oxides of carbon, nitrogen, sulfur

2/ it can damage non-replaceable buildings, statues, and sculptures

3/ it affects breathing and lung problems in children and adults who have asthma

4/ none of these

\_\_\_\_\_ 11. A food web consists of 1/ the animals that eat other animals in a community

2/ all the herbivores and carnivores in an ecosystem 3/ many interconnected food chains

4/ all the consumers in an ecosystem

\_\_\_ 12. The rate of species' extinction is higher now than at any time since the period of the dinosaurs' extinction. The main cause of this rapid decline in biodiversity is

1/ Habitat alteration by human beings 2/the illegal collection of animals and plants 3/changes in the earth's atmosphere due to human activities 4/hunting by humans for food or sport

\_\_\_ 13. In the long term, which of the following would be the best way to lessen the problem of solid waste?  
1/incinerate waste materials 2/reduce the amount of materials being consumed

3/reuse materials for other purposes rather than throwing them out

4/recycle materials that can be used again

\_\_\_ 14. Some insecticides that were once effective in killing insects no longer well. This is because 1/ new insect species develop every day 2/the wrong kind of insecticides were used

3/insects with natural resistance survived and multiplied

4/ the insects produced many more off springs than the insecticide could kill

\_\_\_ 15. *"Things have always being changed. Evolution is all about survival of the fittest, and some things must disappear. We humans are now the fittest and strongest and we have the right to use the world resource for our benefit. We need the space and we have to change environments. If some plants and animals suffer, hard luck."*

This quotation reflects the view of 1/self-centered view 2/environmentalists' view 3/ conservationist view 4/Darwin's view

\_\_\_ 16. Which of the following is **not** a series problem in developing countries?

1/industrial pollution 2/ deforestation 3/unemployment 4/poverty

\_\_\_ 17. Which measure is **the best** to save the endangered animals from extinction?

1/keeping animals in national parks 1/keeping animals in game reserves

3/drawing a strict law for protection 4/keeping animals in sanctuaries

\_\_\_ 18. Which of the following is **not true** of the elements of natural environment?

1/ they exist independently 2/they are dependent one another 3/human intervention affect their balance 4/they may be destroyed forever if they are not preserved

\_\_\_ 19. Which one of the following is **not an agent** for environmental pollution?

1/ Transportation 2/ industrial wastes 3/ improper household waste disposal

4/ using non-toxic, phosphate-free, biodegradable soaps and detergents.

\_\_\_20. Which one of the following is **not the effect** of rapid population growth on the

Environment? 1/ overgrazing and overcutting of woods 2/increase use of insecticides and fertilizers 3/indoor and outdoor air pollution 4/environmentally friendly resource consumption

\_\_\_21. Who is responsible for the environmental problem(s) that Ethiopia faces today?

1/ rich countries 2/ environmental experts 3/the government 4\ every citizen

\_\_\_22. Which of the following describes you best about “two trees for 2000 project” implemented since June 1999 E.C in relation to launching the new Ethiopian millennium?

1/ I have planted two trees 2/ I have planted two trees and still caring them

3/ I did not participate at all 4/ I have no idea at all

\_\_\_23. What is the name of the primary federal agency in Ethiopia established in 1997 that works to protect the environment? \_\_\_\_\_

**Attitude category** (adopted from the revised New Environmental Paradigm (NEP) Scale by Dunlap and et al,2000)

The following items are supposed to measure participants *feeling using the following key*

**1=strongly agree, 2=agree, 3 =no opinion, 4= disagree, 5=strongly disagree**

\_\_\_24. We are approaching the limit of the number of people the Earth can support.

\_\_\_25. Humans have the right to modify the natural environment to suit their needs.

\_\_\_26. When humans interfere with nature it often produces disastrous consequences.

\_\_\_27. Science and technology can overcome any environmental problem.

\_\_\_28. Humans are severely abusing the environment.

\_\_\_29. The Earth has plenty of natural resources if we just learn how to develop them.

\_\_\_30. Plants and animals have as much right as humans to exist.

\_\_\_31. The balance of nature is strong enough to cope with the impacts of modern industrial nations.

\_\_\_32. The Earth has very limited room and resources.

\_\_\_33. Humans were meant to rule over the rest of nature.

\_\_\_34. The balance of nature is very delicate and easily upset.

\_\_\_35. If things continue on their present course, we will soon experience a major ecological catastrophe.

- \_\_\_ 36. I think each of us can make a significant contribution to environmental protection
- \_\_\_ 37. I am willing to have environmental problems solved even if this means sacrificing many goods
- \_\_\_ 38. Environmental problems make the future of the world look bleak and hopeless
- \_\_\_ 39. People worries too much about environmental problems
- \_\_\_ 40. Threats to the environment are not my business
- \_\_\_ 41. I believe that environmental illiteracy is the main cause of environmental problem(s)
- \_\_\_ 42. Science and technology are the cause of the environmental problems
- \_\_\_ 43. It is right to use animals in medical experiments if this can save human lives\*
- \_\_\_ 44. I believe that our government should not give license for industry owners if their plants have serious impact on our environment
- \_\_\_ 45. I will buy my own car in the future whatever quality \*

*Practical (behavioral) action section (adapted from General ecological behavior (GEB) by Kaiser et al., 1999)*

*The following group of statements are supposed to indicate how frequently participants do each of the actions, using the following key.*

*1= almost always, 2=often, 3=sometimes, 4= almost never, 5= never*

**Prosocial behavior items:**

- \_\_\_ 46. If an elderly or disabled person enters a crowded bus or subway, I offer him or her my seat.
- \_\_\_ 47. If I were an employer I would consider hiring a person previously convicted of a crime.
- \_\_\_ 48. If a friend or relative had to stay in hospital for a week or two for minor surgery \_e.g. appendix, broken leg., I would visit him or her.
- \_\_\_ 49. Sometimes I ride public transportation without paying a fare or entrance fee.\*

**Environmental behavior**

- \_\_\_ 50. I talk to people that I notice doing something that harms the environment in an effort to stop that person's activity (for example, try to burn or bury wastes instead of dumping to the environment)
- \_\_\_ 51. I keep papers which are printed on one side in order to write on the other side
- \_\_\_ 52. I do visit parks and zoos
- \_\_\_ 53. I turn off light in rooms which are not being used to conserve electricity
- \_\_\_ 54. I plant trees or flowers on a yearly bases
- \_\_\_ 55. I talk with friends about problems related to the environment

- \_\_\_ 56. In the past, I pointed out to someone his/ her unfriendly environmental behavior
- \_\_\_ 57. I set a positive environmental example for my friends to follow
- \_\_\_ 58. For shopping, I prefer paper bags to plastic ones.
- \_\_\_ 59. I am willing to take part in digging waste disposal pits
- \_\_\_ 60. I talk with families about land degradation and its consequences
- \_\_\_ 61. I am ready to take part in community awareness creation activities
- \_\_\_ 62. I bring back unused medicine to the pharmacy
- \_\_\_ 63. I am a member of and contribute money to an environmental organization
- \_\_\_ 64. I bring bottles, glasses, paper, plastic, dead batteries and / or metal wastes in to a recycling bin or dust bin.
- \_\_\_ 65. I make a point of reading newspaper and magazine articles or watch TV about the environment
- \_\_\_ 66. I talk to my family and friends about what they can do to help solve environmental problems
- \_\_\_ 67. I purchase one product over another product because it is packed in reusable, returnable or recyclable containers or packages
- \_\_\_ 68. I support candidates for political offices who are concerned about environmental problems and issues

\*- negatively stated statement

#### Source of environmental issues

69. How much do you think you know about environmental issues and problems?  
 1/ a lot 2/ a fair amount 3/ only a little 4/ practically nothing

70. Rank the following possible sources of information from the lowest to the highest contribution in helping you to know more about environmental issues and problems

\_\_\_ various school education system

\_\_\_ TV and radio

\_\_\_ News paper and magazines

\_\_\_ parents and friends

\_\_\_ age/self experience

## Appendix -D

### Semi-structured interview for stake holders

Venue \_\_\_\_\_ Date \_\_\_\_\_ Time \_\_\_\_\_

Hello. I am Taye Alamirew and I am a Graduate student in the Institute of Educational Research, Addis Ababa University. I am conducting my thesis on environmental literacy, goal of environmental education.

The purpose of the study is to measure environmental literacy (EL) of undergraduate University students, and to examine differences in scores on components of environmental literacy (Knowledge, attitude and verbal commitment) by gender, academic stream, residence back ground area, and class standing sub populations.

Dear expert, the objective of this interview is to gather supplementary professional information that will enrich my thesis argument. So, I assure you all the information you provide will be purely for academic purpose and will be kept secret.

Thank you!

#### 1. Ministry of Education (MOE) Experts

1.1. Historically, EE began in 1985 in the form of conservation project. How do environmental issues currently addressed at different level of education in general and tertiary level in particular to change the attitudes and behaviors of students? What important activities had been carried out?

1.2. Is there a 'Guiding document' on environmental Education of Ethiopia available at tertiary level?

1.3. What problems did you face and would like to recommend for further action

#### 2. Environmental Protection Authority of Ethiopia, EPA

2.1. What are the roles of EE department in this authority?

2.2. What are the efforts made to change the attitude and behavior of students in general and university students in particular toward environmental literacy and sustainability?

2.3. Any typical activities carried on to change the understanding, attitudes and behaviors of university students

2.4. What problems did you encounter and solutions you would like to suggest

### **3. University Department heads and / or Deans**

3.1. Is there any environmental literacy program?

3.2. What are your managerial and academic commitments in the process of environmental literacy building for students?

3.3. Are there any aspect of interaction and collaboration between your department /faculty and others (departments, community, NGOs etc) in relation to environment and sustainability?

### **4. University instructors**

4.1. The issue of an environment is an issue of every citizen, but for instructors like you more than any individual can do is expected. What is your contribution in addressing environmental issues (local, national and global) in the classroom, establishing and coordinating environmental clubs, and preparing environmental forums?

4.2. What are your professional and academic commitments in the process of environmental literacy building for students?

4.3. Are there any aspect of interaction and collaboration among university community of which instructors are actively participating toward environmental protection and resource wise utilization?

## **Appendix- E**

### **Focus Group Discussion (FGD)**

#### **1. Personal reflection:**

Comment on the relationship between human beings and environment (nature) in the past, at present and in the future

2. Mention any of three environmental problems that you think Ethiopia/globe is facing or will face and suggest the possible causes, effects and solutions for the problem

3. Who is responsible for the local/ global environmental problems that our country/ world are facing today? Why?

## Appendix- F: pilot study results for knowledge and practice

Knowledge assessment: 17 multiple choice items

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|------------------|--|------------|
| .628             | .708   | 17         |

### Item Statistics

| Items | Mean   | Std. Deviation | N  |
|-------|--------|----------------|----|
| it1   | 1.9688 | .17678         | 32 |
| it2   | 3.1250 | 1.28891        | 32 |
| it3   | 3.8125 | .53506         | 32 |
| it4   | 3.0313 | .89747         | 32 |
| it5   | 2.0313 | .17678         | 32 |
| it6   | 2.8125 | 1.25563        | 32 |
| it7   | 3.1875 | .64446         | 32 |
| it8   | 2.6875 | .82060         | 32 |
| it9   | 3.2500 | 1.27000        | 32 |
| it10  | 3.5313 | .94985         | 32 |
| it11  | 2.7813 | .75067         | 32 |
| it12  | 2.8438 | .62782         | 32 |
| it13  | 2.7500 | 1.24434        | 32 |
| it15  | 3.0313 | 1.35562        | 32 |
| it16  | 3.3750 | .90696         | 32 |
| it17  | 3.9688 | .17678         | 32 |
| it18  | 3.1875 | .59229         | 32 |

Item-Total Statistics

|      | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|------|----------------------------|--------------------------------|----------------------------------|------------------------------|----------------------------------|
| it1  | 49.4063                    | 31.926                         | .594                             | .902                         | .615                             |
| it2  | 48.2500                    | 31.226                         | .018                             | .593                         | .661                             |
| it3  | 47.5625                    | 31.093                         | .296                             | .940                         | .612                             |
| it4  | 48.3438                    | 27.846                         | .474                             | .659                         | .579                             |
| it5  | 49.3438                    | 32.943                         | .084                             | .528                         | .629                             |
| it6  | 48.5625                    | 27.802                         | .284                             | .759                         | .608                             |
| it7  | 48.1875                    | 30.157                         | .363                             | .704                         | .602                             |
| it8  | 48.6875                    | 29.964                         | .279                             | .693                         | .608                             |
| it9  | 48.1250                    | 29.403                         | .155                             | .504                         | .634                             |
| it10 | 47.8438                    | 29.749                         | .241                             | .773                         | .613                             |
| it11 | 48.5938                    | 31.862                         | .085                             | .694                         | .632                             |
| it12 | 48.5313                    | 29.999                         | .400                             | .697                         | .599                             |
| it13 | 48.6250                    | 29.016                         | .193                             | .523                         | .626                             |
| it15 | 48.3438                    | 27.201                         | .290                             | .774                         | .608                             |
| it16 | 48.0000                    | 27.032                         | .561                             | .906                         | .565                             |
| it17 | 47.4063                    | 32.765                         | .172                             | .905                         | .627                             |
| it18 | 48.1875                    | 30.738                         | .313                             | .756                         | .609                             |

Since the item-total correlation for items 2,5,9 and 11 is weakly correlated with over all scale and their Cronbach's Alpha if Item Deleted is greater than the overall alpha for the entire scale (alpha=.628), it suggests that either items 2,5 ,9 and 11 should be eliminated or rewritten.

Step by step removal of items 2, 9 and 11 respectively and re-run the item-total statistics gives the following statistics

Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|------------------|--|------------|
| .707             | .748   | 13         |

Item Statistics

|      | Mean   | Std. Deviation | N  |
|------|--------|----------------|----|
| it1  | 1.9688 | .17678         | 32 |
| it3  | 3.8125 | .53506         | 32 |
| it4  | 3.0313 | .89747         | 32 |
| it6  | 2.8125 | 1.25563        | 32 |
| it7  | 3.1875 | .64446         | 32 |
| it8  | 2.6875 | .82060         | 32 |
| it10 | 3.5313 | .94985         | 32 |
| it12 | 2.8438 | .62782         | 32 |
| it13 | 2.7500 | 1.24434        | 32 |
| it15 | 3.0313 | 1.35562        | 32 |
| it16 | 3.3750 | .90696         | 32 |
| it17 | 3.9688 | .17678         | 32 |
| it18 | 3.1875 | .59229         | 32 |

Item-Total Statistics

|      | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|------|----------------------------|--------------------------------|----------------------------------|------------------------------|----------------------------------|
| it1  | 38.2188                    | 25.531                         | .550                             | .879                         | .679                             |
| it3  | 36.3750                    | 24.952                         | .244                             | .867                         | .680                             |
| it4  | 37.1563                    | 21.943                         | .452                             | .514                         | .650                             |
| it6  | 37.3750                    | 21.145                         | .331                             | .671                         | .673                             |
| it7  | 37.0000                    | 23.742                         | .380                             | .618                         | .665                             |
| it8  | 37.5000                    | 23.935                         | .241                             | .628                         | .681                             |
| it10 | 36.6563                    | 22.814                         | .312                             | .731                         | .671                             |
| it12 | 37.3438                    | 24.233                         | .310                             | .634                         | .673                             |
| it13 | 37.4375                    | 21.544                         | .299                             | .490                         | .679                             |
| it15 | 37.1563                    | 20.265                         | .364                             | .670                         | .669                             |
| it16 | 36.8125                    | 21.319                         | .526                             | .861                         | .638                             |
| it17 | 36.2188                    | 26.112                         | .222                             | .769                         | .688                             |
| it18 | 37.0000                    | 24.129                         | .355                             | .697                         | .669                             |

13 items (iem1,3,4,6,7,8,10,12,13,15,16,17 and 18) are accepted and item5 were rewritten taking in to consideration experts opinion .all over 14 items that assesses students environmental knowledge were approved to be used for final work

## Reliability of practice testing

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|------------------|--|------------|
| .720             | .726   | 17         |

### Item Statistics

|        | Mean   | Std. Deviation | N  |
|--------|--------|----------------|----|
| item38 | 2.2333 | 1.04000        | 30 |
| item39 | 2.4000 | 1.22051        | 30 |
| item40 | 1.7667 | .93526         | 30 |
| item41 | 2.7333 | 1.17248        | 30 |
| item42 | 2.5000 | 1.19626        | 30 |
| item43 | 2.3333 | .99424         | 30 |
| item44 | 2.0000 | .90972         | 30 |
| item45 | 2.4000 | 1.03724        | 30 |
| item46 | 2.4667 | 1.13664        | 30 |
| item47 | 2.3667 | 1.09807        | 30 |
| item48 | 1.5667 | .85836         | 30 |
| item49 | 2.0000 | .98261         | 30 |
| item50 | 2.8333 | 1.01992        | 30 |
| item51 | 2.3000 | 1.17884        | 30 |
| item52 | 2.1000 | 1.02889        | 30 |
| item53 | 2.3667 | 1.27261        | 30 |
| item54 | 2.8333 | 1.11675        | 30 |

Though the reliability coefficient ( $\alpha = 0.720$ ) is acceptable, observing an inter item correlation matrix output of items 41 and 53 correlates negatively with most of the other items suggesting the need for elimination of such items from the scale and further re-run the reliability analysis. Removal of items 40 and 52 and an application SPSS for reliability test yield a Cronbach alpha=0.760. As a result 15 items (items 37,38,39,41,42,43,44,45,46,47,48,49,50,51 and 53) were retained for the final study of this project

## Reliability of practice testing

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|------------------|--|------------|
| .720             | .726   | 17         |

### Item Statistics

|        | Mean   | Std. Deviation | N  |
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| item38 | 2.2333 | 1.04000        | 30 |
| item39 | 2.4000 | 1.22051        | 30 |
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| item41 | 2.7333 | 1.17248        | 30 |
| item42 | 2.5000 | 1.19626        | 30 |
| item43 | 2.3333 | .99424         | 30 |
| item44 | 2.0000 | .90972         | 30 |
| item45 | 2.4000 | 1.03724        | 30 |
| item46 | 2.4667 | 1.13664        | 30 |
| item47 | 2.3667 | 1.09807        | 30 |
| item48 | 1.5667 | .85836         | 30 |
| item49 | 2.0000 | .98261         | 30 |
| item50 | 2.8333 | 1.01992        | 30 |
| item51 | 2.3000 | 1.17884        | 30 |
| item52 | 2.1000 | 1.02889        | 30 |
| item53 | 2.3667 | 1.27261        | 30 |
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Though the reliability coefficient ( $\alpha = 0.720$ ) is acceptable, observing an inter item correlation matrix output of items 41 and 53 correlates negatively with most of the other items suggesting the need for elimination of such items from the scale and further re-run the reliability analysis. Removal of items 40 and 52 and an application SPSS for reliability test yield a Cronbach alpha=0.760. As a result 15 items (items 37,38,39,41,42,43,44,45,46,47,48,49,50,51 and 53) were retained for the final study of this project

### Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|------------------|--|------------|
| .760             | .758   | 15         |

### Item Statistics

|        | Mean   | Std. Deviation | N  |
|--------|--------|----------------|----|
| item38 | 2.2903 | 1.07062        | 31 |
| item39 | 2.4194 | 1.20483        | 31 |
| item40 | 1.7742 | .92050         | 31 |
| item42 | 2.4839 | 1.17958        | 31 |
| item43 | 2.3871 | 1.02233        | 31 |
| item44 | 2.0645 | .96386         | 31 |
| item45 | 2.4194 | 1.02548        | 31 |
| item46 | 2.4516 | 1.12068        | 31 |
| item47 | 2.4194 | 1.11876        | 31 |
| item48 | 1.5484 | .85005         | 31 |
| item49 | 2.0000 | .96609         | 31 |
| item50 | 2.8710 | 1.02443        | 31 |
| item51 | 2.3548 | 1.19857        | 31 |
| item52 | 2.1613 | 1.06761        | 31 |
| item54 | 2.8710 | 1.11779        | 31 |

**Item-Total Statistics**

|        | Scale Mean if<br>Item Deleted | Scale<br>Variance if<br>Item Deleted | Corrected<br>Item-Total<br>Correlation | Squared<br>Multiple<br>Correlation | Cronbach's<br>Alpha if Item<br>Deleted |
|--------|-------------------------------|--------------------------------------|--|------------------------------------|--|
| item38 | 32.2258                       | 48.514                               | .568                                   | .616                               | .727                                   |
| item39 | 32.0968                       | 52.490                               | .240                                   | .385                               | .760                                   |
| item40 | 32.7419                       | 55.331                               | .142                                   | .430                               | .764                                   |
| item42 | 32.0323                       | 52.832                               | .227                                   | .371                               | .761                                   |
| item43 | 32.1290                       | 52.716                               | .294                                   | .602                               | .753                                   |
| item44 | 32.4516                       | 51.256                               | .430                                   | .540                               | .741                                   |
| item45 | 32.0968                       | 55.157                               | .126                                   | .392                               | .767                                   |
| item46 | 32.0645                       | 48.996                               | .502                                   | .668                               | .733                                   |
| item47 | 32.0968                       | 48.890                               | .510                                   | .541                               | .732                                   |
| item48 | 32.9677                       | 53.966                               | .275                                   | .618                               | .754                                   |
| item49 | 32.5161                       | 50.391                               | .496                                   | .678                               | .736                                   |
| item50 | 31.6452                       | 51.037                               | .413                                   | .536                               | .742                                   |
| item51 | 32.1613                       | 47.273                               | .571                                   | .755                               | .725                                   |
| item52 | 32.3548                       | 50.837                               | .404                                   | .545                               | .743                                   |
| item54 | 31.6452                       | 52.837                               | .249                                   | .523                               | .758                                   |

## Appendix G: PCA

### Knowledge section

Total variance of knowledge section explained

| Component | Initial Eigenvalues |               |              | Extraction Sums of Squared Loadings |               |              |
|-----------|---------------------|---------------|--------------|-------------------------------------|---------------|--------------|
|           | Total               | % of Variance | Cumulative % | Total                               | % of Variance | Cumulative % |
| 1         | 2.208               | 15.774        | 15.774       | 2.208                               | 15.774        | 15.774       |
| 2         | 1.310               | 9.354         | 25.128       | 1.310                               | 9.354         | 25.128       |
| 3         | 1.300               | 9.289         | 34.417       | 1.300                               | 9.289         | 34.417       |
| 4         | 1.180               | 8.431         | 42.848       | 1.180                               | 8.431         | 42.848       |
| 5         | 1.014               | 7.241         | 50.090       | 1.014                               | 7.241         | 50.090       |
| 6         | 1.003               | 7.166         | 57.256       | 1.003                               | 7.166         | 57.256       |
| 7         | .948                | 6.772         | 64.028       |                                     |               |              |
| 8         | .861                | 6.152         | 70.180       |                                     |               |              |
| 9         | .818                | 5.841         | 76.021       |                                     |               |              |
| 10        | .762                | 5.443         | 81.464       |                                     |               |              |
| 11        | .751                | 5.361         | 86.826       |                                     |               |              |
| 12        | .722                | 5.160         | 91.985       |                                     |               |              |
| 13        | .632                | 4.514         | 96.499       |                                     |               |              |
| 14        | .490                | 3.501         | 100.000      |                                     |               |              |

Extraction Method: Principal Component Analysis.

Component score coefficient matrix (a): knowledge section

|     | Component |       |       |       |       |       |
|-----|-----------|-------|-------|-------|-------|-------|
|     | 1         | 2     | 3     | 4     | 5     | 6     |
| C1  | .240      | -.284 | -.529 | .249  | .250  | .101  |
| C2  | .402      | .045  | .222  | .465  | .137  | .157  |
| C3  | .227      | .274  | -.370 | .538  | .025  | .260  |
| C4  | .321      | -.155 | .539  | .348  | -.143 | .100  |
| C5  | .568      | -.166 | -.257 | -.043 | -.325 | -.285 |
| C6  | .475      | .499  | -.177 | -.169 | .024  | -.207 |
| C7  | .562      | -.026 | .023  | -.366 | .005  | -.064 |
| C8  | -.093     | .576  | .086  | -.181 | .020  | .413  |
| C9  | .282      | .554  | .235  | -.062 | .249  | -.296 |
| C10 | .055      | -.150 | -.042 | -.437 | .285  | .602  |
| C11 | .481      | .023  | -.270 | .013  | .394  | .005  |
| C12 | .499      | .089  | .307  | .064  | -.347 | .307  |
| C13 | .239      | -.320 | .461  | -.019 | .571  | -.160 |
| C14 | .584      | -.280 | -.041 | -.307 | -.242 | .152  |

Extraction Method: Principal Component Analysis. a 6 components extracted.

Attitude section

Total variance of attitude section explained

| Component | Initial Eigenvalues |               |              | Extraction Sums of Squared Loadings |               |              |
|-----------|---------------------|---------------|--------------|-------------------------------------|---------------|--------------|
|           | Total               | % of Variance | Cumulative % | Total                               | % of Variance | Cumulative % |
| 1         | 2.162               | 13.510        | 13.510       | 2.162                               | 13.510        | 13.510       |
| 2         | 1.970               | 12.310        | 25.821       | 1.970                               | 12.310        | 25.821       |
| 3         | 1.461               | 9.132         | 34.952       | 1.461                               | 9.132         | 34.952       |
| 4         | 1.368               | 8.553         | 43.505       | 1.368                               | 8.553         | 43.505       |
| 5         | 1.232               | 7.698         | 51.203       | 1.232                               | 7.698         | 51.203       |
| 6         | 1.054               | 6.587         | 57.791       | 1.054                               | 6.587         | 57.791       |
| 7         | .959                | 5.992         | 63.782       |                                     |               |              |
| 8         | .923                | 5.767         | 69.549       |                                     |               |              |
| 9         | .876                | 5.474         | 75.023       |                                     |               |              |
| 10        | .752                | 4.702         | 79.725       |                                     |               |              |
| 11        | .682                | 4.263         | 83.988       |                                     |               |              |
| 12        | .605                | 3.779         | 87.767       |                                     |               |              |
| 13        | .603                | 3.769         | 91.536       |                                     |               |              |
| 14        | .524                | 3.277         | 94.813       |                                     |               |              |
| 15        | .467                | 2.921         | 97.734       |                                     |               |              |
| 16        | .363                | 2.266         | 100.000      |                                     |               |              |

Extraction Method: Principal Component Analysis.

Component score coefficient matrix (a): attitude section

|     | Component |       |       |       |       |       |
|-----|-----------|-------|-------|-------|-------|-------|
|     | 1         | 2     | 3     | 4     | 5     | 6     |
| A15 | .069      | .545  | -.004 | -.121 | .061  | -.430 |
| A16 | .233      | -.026 | -.149 | -.110 | .336  | .411  |
| A17 | .061      | .442  | .441  | -.243 | .272  | .028  |
| A18 | .048      | .573  | .145  | -.061 | -.246 | .493  |
| A19 | .333      | .243  | -.553 | .073  | -.026 | -.101 |
| A20 | .512      | .255  | -.396 | -.106 | .327  | -.002 |
| A21 | .218      | .547  | .053  | .397  | .261  | -.050 |
| A22 | -.209     | .021  | -.290 | .668  | .067  | .132  |
| A23 | -.028     | -.112 | .404  | .532  | .192  | .341  |
| A24 | .356      | -.121 | -.295 | .050  | -.623 | .052  |
| A25 | .529      | -.226 | .370  | .219  | .210  | -.419 |
| A26 | .707      | -.068 | .016  | .110  | -.050 | .242  |
| A27 | .524      | -.390 | .314  | .231  | -.253 | -.142 |
| A28 | .585      | -.298 | -.104 | -.273 | .244  | .149  |
| A29 | .328      | .473  | .391  | -.124 | -.431 | .056  |
| A30 | .044      | .421  | -.159 | .412  | -.135 | -.169 |

Extraction Method: Principal Component Analysis.

a 6 components extracted.

## Practice section

### Total Variance of behavioral practice explained

| Component | Initial Eigenvalues |               |              | Extraction Sums of Squared Loadings |               |              |
|-----------|---------------------|---------------|--------------|-------------------------------------|---------------|--------------|
|           | Total               | % of Variance | Cumulative % | Total                               | % of Variance | Cumulative % |
| 1         | 2.767               | 18.449        | 18.449       | 2.767                               | 18.449        | 18.449       |
| 2         | 1.750               | 11.665        | 30.114       | 1.750                               | 11.665        | 30.114       |
| 3         | 1.513               | 10.089        | 40.204       | 1.513                               | 10.089        | 40.204       |
| 4         | 1.175               | 7.833         | 48.037       | 1.175                               | 7.833         | 48.037       |
| 5         | 1.125               | 7.502         | 55.538       | 1.125                               | 7.502         | 55.538       |
| 6         | .933                | 6.223         | 61.761       |                                     |               |              |
| 7         | .882                | 5.877         | 67.638       |                                     |               |              |
| 8         | .826                | 5.506         | 73.144       |                                     |               |              |
| 9         | .748                | 4.986         | 78.130       |                                     |               |              |
| 10        | .640                | 4.269         | 82.400       |                                     |               |              |
| 11        | .624                | 4.161         | 86.561       |                                     |               |              |
| 12        | .606                | 4.039         | 90.600       |                                     |               |              |
| 13        | .541                | 3.607         | 94.207       |                                     |               |              |
| 14        | .489                | 3.261         | 97.467       |                                     |               |              |
| 15        | .380                | 2.533         | 100.000      |                                     |               |              |

Extraction Method: Principal Component Analysis.

Component score coefficient matrix (a): practice section

|     | Component |       |       |       |       |
|-----|-----------|-------|-------|-------|-------|
|     | 1         | 2     | 3     | 4     | 5     |
| B31 | .451      | -.227 | -.355 | .354  | .305  |
| B32 | .296      | .253  | -.419 | .274  | -.160 |
| B33 | .345      | -.561 | .188  | -.058 | -.018 |
| B34 | .241      | .184  | -.498 | .522  | .231  |
| B35 | .613      | -.093 | -.095 | -.101 | -.337 |
| B36 | .427      | -.025 | -.112 | -.129 | .239  |
| B37 | .211      | -.558 | .450  | .338  | .214  |
| B38 | .256      | .409  | .455  | .398  | .155  |
| B39 | .335      | .608  | .082  | -.158 | -.071 |
| B40 | .610      | -.411 | .091  | -.071 | -.061 |
| B41 | .290      | .123  | .232  | .381  | -.667 |
| B42 | .466      | .340  | .142  | -.298 | .480  |
| B43 | .628      | -.131 | -.201 | -.251 | -.100 |
| B44 | .374      | .304  | .591  | .069  | .086  |
| B45 | .559      | .143  | -.139 | -.261 | -.105 |

Extraction Method: Principal Component Analysis. a 5 components extracted

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## DECLARATION

I hereby declare that this thesis is my original work, and had not been presented for a degree to any university and that all relevant sources used are duly acknowledged.

Name Taye Alamirew

Signature \_\_\_\_\_

Date of Submission June 13, 2008

This thesis has been submitted for examination with my approval as a university advisor

Name Firdissa Jebessa (Ato)

Signature \_\_\_\_\_

Date June 13, 2008

## Appendix – VIII

**Check List -- all sample secondary schools along with the number of teachers in 1998 E.C**

| No           | Sub city     | School's name       | Male       | Female     | Qualified  |
|--------------|--------------|---------------------|------------|------------|------------|
| 1            | Bole         | Dr. Addsi Alemayehu | 11         | 3          | 14         |
| 2            | Yeka         | Kokebe Tsibah       | 83         | 24         | 107        |
| 3            | Arada        | Minilik II          | 133        | 15         | 148        |
| 4            | Gulele       | Medhanialem         | 120        | 14         | 134        |
| 5            | Lideta       | Africa Hibret *     | 62         | 24         | 86         |
| 6            | Addis Ketema | Addsi Ketema        | 106        | 2          | 108        |
| 7            | Kolfe        | Ayer Tena           | 82         | 19         | 101        |
| 8            | Chirkos      | Misrak Ber *        | 49         | 10         | 59         |
| 9            | Nefas silk   | Ginbot 20           | 39         | 2          | 41         |
| 10           | Akaki        | Derartu Tulu        | 50         | 12         | 62         |
| <b>TOTAL</b> |              |                     | <b>735</b> | <b>125</b> | <b>860</b> |

\*N.B. Except, Africa Hibret and Misrak Ber which were newly opened schools, the data for the schools above was collected from the education statistics annual abstract 1998 E.C/2006

The current (1999-2001) data (information) of the schools in A.A could not be found in a document or organized form in either of the A.A administrative education bureau of in the MOE. However, it was possible to collect the current data directly from the schools. But, in order to be tangible, the researcher has decided to take information from documents as much as possible, although they did not represent the current situation.