

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

ACTIVITY ORIENTED SCIENCE TEACHING IN SOME PRIMARY
SCHOOLS OF JIMMA ZONE: A LOOK FOR CONGRUENCE BETWEEN
INTENT AND PRACTICE

TEHSOME TOLA

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INTENT AND PRACTICE

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TESHOME TOLA

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Approved by the Board of Examiners

Chairman, Department
Graduate Committee

Signature

Advisor

Signature

Examiner, External

Signature

Examiner, Internal

Signature

DECLARATION

I hereby declare that this thesis is my original work done under the guidance of Dr Marew Zewidie and Dr Temechegn Engida, and that it has not been presented for a degree in any other university. All relevant sources of information used in this thesis have been dully acknowledged.

Name: Teshome Tola

Signature -----

Date; 20 May, 2003

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

Name: Temechegn Engida (Ph.D)

Signature-----

Date

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Abstract

This study examined the congruence between the methods/activities suggested in the grade five basic science syllabus currently being used in primary schools of Oromia region, and those actually employed in the instructional practice. Activity analysis was conducted on the syllabus using a coding sheet designed for this purpose. 18 daily lesson plans prepared by nine grade five science teachers were analyzed for the taxonomic levels of objectives and activities selected to attain them. The implementations of the planned lessons were also observed using in observation checklist in nine classrooms over two semesters. The classroom teaching learning activities were coded every 15 seconds which provided a maximum of 160 frequencies for each 40 minutes period and a total of 2835 for the 18 lessons (45 off task behaviors were noted).The kinds of activities either suggested in the syllabus or observed in the daily lesson plans and the actual classroom practice were classified into three major categories as *Discussion, Recording and Experiment*. The frequencies of the various activities were counted and entered into tables by their respective categories. Percentage calculations and participation index were used to estimate the level of student involvement in the suggested, planned, and/or implemented learning activities. The findings showed that all the teaching learning activities were more teacher dominated except those suggested for recording. A wide gap was evident between intent and practice that the kinds of magnitude of activities actually observed in the instructional practice differed from those

intended by the syllabus as well as the teachers' plans. The study suggests that the syllabus be revised and improved and attention be given to teacher training both in pre-service and in-service programs.

Chapter One

The Problem and its Approach

1.1 Back ground

Most educators for several reasons accept that activity oriented teaching should play a major role in science education. Some of these are psychological while the rest are developmental. Piaget's theory of cognitive development suggests that concrete and direct methods of instruction need to be employed when dealing with preoperational or concrete operational thinkers, while strategies involving abstract thinking should be used with formal operational thinkers (Jinks, 1997: Martain, et al 1997).

Penner, et.al (1993) on their part believe that for any instructional practice to be effective, it must focus on the active involvement of students in their own learning with opportunities for teacher and peer interaction. Furthermore, a good activity oriented practice need to encourage problem solving, debates, group discussion, practical work (experimentation) and other strategies that enhance the development of higher order thinking.

Engaging students in hands-on as well as minds-on activities help as a means to promote scientific literacy which according to some writers is the goal of most science education reform everywhere in the world (Martin, 1997: Bajah, 1996). Besides these, such a strategy plays a prominent role in fostering the natural curiosity of students and helps them develop into mature investigative ness that make their adult lives more full. Dobe, et al

(1999) argue that children would grow afraid of science and tend to distance themselves from the subject, unless taught in a way that appeal to their needs and interests.

Thus, involvement of students in activity oriented learning helps them to develop positive attitude toward the subject whether they continue to specialize in it, or change their career to non-science areas, or terminate their schooling at some point. It is boldly true to claim that scientifically literate individuals with positive attitude would grow adults capable of solving their societal problems which they form a part. Cognizant of this, the Ethiopian Education and Training Policy (TGE, 1994a) advocates that the aims of education must be to strengthen the individual's and society's problem solving capacity, ability and culture at all levels. some of the general and specific objectives of the Ethiopian education as stated under article 2.1.4 and 2.2.2 are to:

- *Bring up citizens... who show positive attitude towards the development and dissemination of science and technology in the society.*
- *Develop and enrich students' inquisitive ability and raise their creativity...*

The notion of developing inquisitive curiosity, problem solving capacity, and critical thinking ability is best achieved when school subjects cater for addressing these goals. One of the subjects that promote the abovementioned abilities is science. The strategic plan for translating the

policy objectives in to the school curriculum, places great emphasis on science, together with mathematics and language education. As distinct from the rest of the curricular elements, the teaching of science is given a special emphasis in that it has to focus on application and be related to student activities. This was clearly indicated in the education sector strategy (TGE,1994b) as under.

The science, mathematics and language components will be strengthened so that students have good grounding in these subjects from early on. The teaching of science will emphasize application and will be properly linked with day to day activities of the student.

Following this, contents and learning experiences had already been selected and put in use in the school system. Whether the design of the current curricular materials and the instructional practices are in line with the national aims and goals, has to be verified through research and solutions sought for the problems identified by the research studies.

Although science teaching is one of the potential areas for educational research, very few works exist on the teaching of science in Ethiopian schools. Most of the available studies conducted on the former and the current curricula identified the major problems associated with effective teaching of the subject mainly at the secondary level focusing on specific subjects. Mekuanent (1992), for example, conducted *An Evaluation of the Teaching of Biology Vis-À-Vis Enquiry Model*, and found out that a gap exists between the teaching of the subject and the approach called for by the

curricular materials. According to this study, the major reasons for the mismatch between the intended approach and the actual practice fall into two categories. On one hand, the textbooks were unrealistic in nature that they demanded too much from the student to engage in inquiry. On the other hand, biology teachers were unfamiliar with the application of the inquiry approach.

An experimental study conducted by Temechegn (1993) on the teaching of Grade 11 chemistry with regard to “the impact of Instructional functions approach on student achievement”, showed that the treatment was generally effective in the sense that when the instructional treatment was implemented it has a positive impact on student achievement.

Negussie’s (1998) study of the natural science syllabus for the TTIs showed that the teaching methods suggested in the syllabus were teacher centered. In addition, it revealed that the natural science syllabus was not relevant to implement the primary school syllabus. On top of these the instructors tended to give more emphasis to non-integrated course areas while the trainees were to be prepared for teaching integrated science in the primary schools. One other study focusing on the primary school sciences was conducted by Temesgen (2001). As depicted by this study although 98% of the science teachers accept the importance of elements of constructivist strategies, only rarely were these elements applied in the teaching learning

process. The study also identified factors militating against the application of constructivist strategies.

Although the studies mentioned above attempted to address the most pressing problems of science teaching, they all focused on Addis Ababa except the one conducted by Negussie (1998).

1.2 Statement of the Problem

The fact that the various regions of the country are now free to develop their own curricular materials based on their own local situations would make the importance of conducting study on the realities of each region. Especially, whether the teaching methods suggested in the Basic Science Syllabus for Grade Five, are responsive to the national aim of producing citizens who possess critical thinking ability, and problem solving capacity through the provision of activity oriented science, deserves close observation.

Usually teachers are left free to decide on the type of activities in which the students are to engage. It is also true that many science teachers strive to create conducive classroom environment that facilitate maximum student learning. However, it would be wrong to expect that all teachers will equally do so.

Objective

Aiming at seeing whether the methods prescribed in the syllabus, are activity oriented (i.e. promote student involvement in some learning tasks) and are actually being applied in the instructional practice or not, this study tries to assess the extent to which teachers plan and implement activity oriented lessons in grade five basic science classrooms drawn from some primary schools of Jimma Zone, which is part of Oromia region. The study aimed at seeking answers to the following research questions.

1. Do the teaching methods prescribed in the syllabus allow student involvement in some activities?
2. Do the teachers plan and implement activity oriented lessons in science classrooms?
 - 2.1 What are the major instructional objectives of teachers?
 - 2.2 What are the major activities planned to achieve these activities?
 - 2.3 Does the classroom instructional practice promote student involvement?
3. To what extent do the classroom instructional practice and teachers' plans relate to each other?
4. What are the constraints?

1.3 Significance of the Study

Scientific and technological advancement in the developed world is making impact on all countries of the world. Ethiopia can not exist in isolation

unless it gets involved in science and technology. It needs to promote scientific literacy among the society by providing science education to school children. To be scientifically literate, individuals need the necessary skills and knowledge basis that help them make reasoned decisions in situations that require an understanding of science and technology. Therefore, improvement of science teaching through research would bear significant effect on the promotion of the literacy goal in science.

Apart from this general role, the student researcher believes that this study would possibly initiate further classroom research in the area. More specifically, however, the research contributes to the improvement of classroom instruction by raising the awareness of science teachers in making careful selection of activities that match their instructional plans and ultimately those of the syllabus.

On top of these, the following institutions would benefit a lot from the findings.

1. Jimma Teachers college would use them as a source of feedback in an attempt to improve its training approach in the pre-service and in-service programs as it shoulders the responsibility of producing effective teachers for the second cycle primary schools. Many primary school teachers working in the Zone are currently attending in-service courses through evening, summer, and distance education programs being conducted by Jimma Teachers Collage. Therefore, the findings would be more important to this institution although other Teachers

Colleges and Science Educators working in them may also draw benefits.

2. The regional education Bureau of Oromia can respond in some way by providing necessary input to the improvement of school science instruction.
3. The Institute for Curriculum Development Research (ICDR) can also use the results as a feedback so that it can make necessary response by conducting revision and improvement of the curricular materials (syllabus) in line with the suggestions forwarded by the study.
4. Other Regional Bureaus throughout the country can also weigh the status of activity oriented science teaching in their respective schools and thus play their roles in making science instruction more learner-centered than what appears to be the reality.

1.4 Delimitation of the Study

Complete information is best obtained when all primary school science curricular materials and classrooms are included in the study. However, time manpower and financial constraints restrict the research to a very limited scope. Taking Jimma zone as a research area, only four Woredas that have transport access namely, Manna, Nadda, Kerssa and Gomma were considered. Nine, grade five classrooms from nine different schools of these Woredas and the basic science syllabus designed for this level were made the focus of this study.

The rationale behind focusing on grade five basic science is the assumption that the subject lays basic foundations for all sciences in the primary schools and thus, improvement in the approach to teaching it at this level would bear considerable effect on the attitude of the students towards science in their future life. As the grade level under discussion represents the entry point to the second cycle primary education, and is far removed from the national examination to be administered at the end of the cycle, teachers may not be much concerned with content coverage, and thus, have the opportunity to put equal emphasis on both hands-on and minds-on activities through involvement of students in different learning tasks.

The study of the basic science syllabus is limited to only the section dealing with the “teaching methods” as these provide the kinds of student and teacher activities to be followed in teaching/learning any given topic. The general aims of the syllabus were also studied to see if the prescribed activities help their realization.

As one instrument of data collection, the lesson plans prepared by grade five science teachers in the nine sample schools were analyzed. This analysis, however, is limited to the instructional “objectives” set by the teachers, and the “teacher and student activities” sections of the less plans only.

1.5 Limitations of the Study

Given the pre arrangements made with the teachers about the date and time of classroom observation during the first phase, it seems that some of the teachers created sort of artificial classroom activities thinking that the researcher has the purpose of conducting classroom supervision. More student directed varieties of activities were observed in the discussion area during this phase, while such activities were very much reduced both in kind and magnitude during the second observation.

Thus, the results of the classroom observation, the researcher believes, might have been changed from the normal practice, mainly due to the prearrangement.

1.6 Definitions of Terms

Activity- In the context of this study, ‘activity’ refers to any physical and mental work in which the students are involved individually or in groups in learning a given lesson. It includes practical works (experiments), problems solving, student demonstrations, recording of practical work results, preparation and presentations of reports and projects student’s oral presentations, student-initiated questions and responses to the questions, responses to ideas or suggestions raised by either the classmates or the teacher, small-group, as well as whole-class discussions.

Activity-oriented- refers to an instructional situation, or a lesson that promotes student involvement in any, or all of the activities mentioned above.

Intent- The desired student activities as expressed by the objectives and methods of teaching in the syllabus as well as the lesson plans.

Practice- Refers to the actual teaching learning process and the student activities in learning a given lesson topic as noted during classroom observation.

Participation index- Is the ratio of the weighted frequencies of both teacher and student activities to the total observed frequencies for each category of activities. It is used to estimate the level of student involvement in learning tasks.

Overall Index of Participation- Refers to the ratio of the sum of weighted activities across the three major categories of activities, to the total frequencies of activities per 40 minutes period for one classroom (see page 75 for details).

Discussion- Refers to both teacher and student oral activities during the instructional practice.

Experiment- Any teaching learning activity that includes the use of concrete physical materials so as to engage in hands on activities. It

includes teacher's demonstrations as well as students practical works either individually or in groups.

Recording- Any writing or drawing activities prescribed, planned, or undertaken by both the teacher and the students. It includes such activities as drawing tables, graphs, charts, diagrams, etc; or copying notes, or taking dictation.

Chapter Two

Review of Literature

This chapter deals with the review of the relevant literature thought to provide background to the study. The chapter treats five subheadings. The first one presents goals of science teaching, followed by activity- oriented curriculum, which forms the second sub heading. The third topic entitled 'problems of teaching science', gives account of the major obstacles that work against the effective teaching of science in schools. The fourth topic discusses the 'role of activity oriented science' in developing the cognitive,

affective and psychomotor skills in the learners, while the fifth and last part of the chapter presents summary of research findings pertaining to the application of activity oriented science teaching.

2.1 Goals of Science Education

Goals of science education have shown dynamism over the last forty years , both in the developed and developing countries. In the 1960's and 1970s, the central purpose was to put youngsters on the road to becoming research scientists and engineers (Bajah 1996).

The focus during these two decades was on the preparation of the talented and able individuals for further studies in science and technology. From 1983 to the present, however, there is a changing emphasis that “science for all”, has been adopted by many countries (Levinson & Thomas, 1997; Jinks, 1997; Martin, et al, 1977). The idea behind this goal is that every society wants its citizens become scientifically literate so as to be able to look at situations from a variety of stand points and make decisions by thinking things out in a clear, logical fashion and weighing up evidence (Parkinson, 1994:1). It is further argued by Parkinson that the world comes in contact with various new developments in science on an everyday basis. To keep abreast with these new developments, every society needs its children to respond in a positive manner by having learned the basic level of scientific literacy at school.

According to Levinson & Thomas (1997:119), the goal of school science as recommended by the science council of Canada, should be to enable students to:

- Participate fully in a technological society as informed citizens
- Pursue further studies in science and technology
- enter the world of work
- develop intellectually and morally

Similarly, Bajah (1996: 20-21) lists four general objectives of science and technology education for all in Africa.

- a) to equip Africans irrespective of present and future career orientations, with basic knowledge, skills and attitudes in science and technology, and enhance potentials for improving the quality of life in the region.
- b) To provide a foundation for further education and training in science and technology for those who will ultimately go into careers in science and technology.
- c) To facilitate the social and economic developments in the region.
- d) To increase the pool of scientists and technologists.

The last point that aims at 'increasing the pool of scientists and technologists', represents the traditional model of the sixties and the seventies which emphasize scientific expertise for the gifted few; and alienates the majority of the learners from science (Temechegn, 2001:68) by presenting abstract concepts as the primary content of importance for the study of science in the school (Levinson and Thomas, 1997:120). With the exception of this, all the goals cited above, both for the developed world as

well as Africa, show that the overall purpose of science education is to make the subject more relevant to the life of the learners.

The question of relevance has remained the intent of the overall curriculum for Ethiopian school system at each curriculum reform endeavors (Seyoum, 1996). In line with the objectives of the Ethiopian Education and Training policy (TGE, 1994a) the Institute for Curriculum Development and Research (ICDR), states that the primary school science program has to be relevant to the students' immediate life and everyday living as well as meet societal needs and problems in the various regions. To realize the attainment of these, the ICDR further stipulates that

The teaching of basic science integrates scientific and technology methods, environmental science, home economics, agriculture and productive technology by stressing the underlying principles and application of scientific knowledge (ICDR, 1994)

When the national curriculum guide and the regional basic science syllabus are closely examined, the general objectives set for grade five basic science course can be summarized as follows:

1. 1. Understand the functions of the systems of humans, plants and animals.
2. develop skills and habit of protecting themselves and others from diseases by keeping their environment in good hygienic conditions
3. Voluntarily participate in the conservation of natural resources.
4. Understand the principles of some simple machines and use them practically.

5. Develop skills of properly using some common tools and handling them carefully.
6. Develop basic scientific and technological skills and processes of problem solving and develop critical thinking (ICDR, 1994; OREB, 1997).

This involves giving the learners opportunities to identify social problems, to participate in suggesting solutions, and taking part in carrying out their suggestions both individually and in groups by practicing and developing a number of human relationship skills and attitudes. For any primary school science program to be effective, UNESCO (1962:22) asserts that children should be helped to develop the skills of cooperation, group planning, etc by providing favorable physical and psychological conditions. To meet the goal of science literacy, students must be actively involved in hands-on experiences (American Association for the Advancement of Science, 1995).

2.2 Activity Oriented Curriculum

The argument for activity oriented curriculum originates from two major sources. On one hand, the theories forwarded by educational psychologists have been influential in science education over many years. On the other hand, the goal of scientific literacy forces the development of such a curriculum for all school children.

The idea shaped by Piaget and his advocates, according to some science educators have affected modern science programs. One of their most persuasive ideas is the fact that “school children in all stages need to share their experiences with others, consider other view points, and evaluate these

social interactions”. When children of different abilities are let to work in a group, they learn from each other in many ways. The concrete thinker serves as influential model to the intuitive thinker, and in turn, gets influenced by students who show formal thinking abilities (Gega 1986:29).

Proponents of discovery learning claim that children learn best when they are confronted with problems, and use their minds to figure out or discover things for themselves. Jerome Bruner, outlines four reasons for using the discovery approach. First, he believes that an individual learns and develops his/ her mind by using it. Second, as a result of succeeding at certain discovery activities, the person derives self-satisfaction, and therefore, internally gets motivated. Thirdly, he claims that the student is not a passive listener, but should be involved actively in the learning process. The idea of active involvement, however, should not be limited to manual/manipulative activities. They must be involved in the learning process by listening to the teacher, peers, and/or audio recordings; by speaking, reading, seeing and thinking. The fourth argument is that children must be helped with memory processing. It is believed that children remember the information they learn when the learning material is organized around their interest (as cited in Carin and Sund, 1989:93-96)

The Ausubelian school of thought, although refutes the importance of discovery for being time consuming, believes that learning should be based on prior knowledge of the children. Ausubel suggests the use of examples and situations already known to the learner, in order that content learning

becomes more meaningful. Thus, he urges that curriculum developers should look for the idea frameworks that children hold before coming to a particular lesson (as reviewed by Parkinson 1994:88).

All the ideas suggested by these theories have implications for curriculum developers in that the design of curriculum materials such as the syllabus and textbooks need to consider the active involvement of the students at all stages. The curriculum must provide opportunities for students to interact with the teacher as well as their peers in group discussions. The various contents to be mastered by the students should also be organized around activities that are challenging, but geared to each developmental level so as to make them think and solve problems on their own with the teacher helping as a guide and facilitator.

Boomer et al (1992), by asking students in Australia how they learn best, have compiled what need to happen if the students have to learn at full power. Accordingly, they summarize the conditions that the curriculum needs to fulfill under three headings: engagement, exploration and reflection.

As these authors further elaborate the conditions, students learn when they become curious or puzzled by the things they are to learn and get internally motivated in their effort to resolve their puzzlements. It is also pointed out that the lesson has to be relevant to the learners in such a way that it builds on what they already know.

With respect to exploration as one of the optimum conditions for student learning, the authors claim that students need to inquire, speculate and hypothesize, test their ideas and engage in trial and error to find out what is new to them, rather than remain passive recipients of teacher's knowledge. To do all these things, they must be provided opportunities to work in pairs, small groups as well as whole class structures depending on the nature of the work. Finally, students must be given opportunities to reflect on what they have learnt, both individually and collectively. The reflection is believed to be the most important source for useful new questions, challenges and direction (Boomer et al, 1992:16-18).

Advocates of the learner centered methodology, such as Louis A. Penner and associates (1993), also recommend that, for a curriculum and instruction reforms to maximize student learning, motivation and achievement, attention needs to be paid to 1) active involvement of the students in their own learning 2) opportunities for teacher and peer interaction 3) integration of active strategies for stimulating interest and heterogeneous and diverse groupings of students for learning activities (Penner, et al 1993:298).

Gott and Mashiter (1991), suggest that a task-based approach to curriculum design must be followed so as to make science less abstract, more relevant and more motivating. To advance these, the curriculum must be constructed around a series of meaningful tasks that foster a sense of ownership of the activities in the students.

2.3 Problems of Teaching Science

The teaching of science suffers from many problems. The problems may vary from country to country or from one school to another. Some of these problems could be pedagogical while others may be physical or psychological in nature. Teachers of science especially at the primary school level may lack enough scientific knowledge to effectively teach the subject (Young, 1979:4). Others do not have adequate training background and experience in practical activities. Many elementary teachers have had minimal science coursework or only general methods course rather than experiences specific to the content and inquiry based methodology of science teaching. As a result they may fail to utilize inquiry, ask effective higher level questions, or integrate science with other subjects (Jones, 1997).

Concerning the inadequacy of training teachers for the Ethiopian secondary schools, a recent study conducted by Temchegn on student teachers of science revealed the existence of a gap between the knowledge acquired at the university and the actual practice in the schools. Some of the explanations for this shocking failure of the university training were found to be that the professional course in science education is offered only for a maximum of 10 weeks period; that there was no single course available for students on school based laboratory experiments; and that there was no integration among the subject matter and pedagogical courses the students receive during their four years university study (Temechegn 2001:73).

Such a deficiency forces the teacher to own a slight confidence in teaching methods other than exposition (Allsop 1991:33). According to Martin (1997:8) the elementary school science teacher does not need to master a large volume of content, but needs to know how children learn. It is only when he/she understands the psychological principles and learning theories that the teacher can design the lesson in a way that engages children in some learning activities that would help them develop mentally and physically.

The process of teaching is another source of problems for teaching science in the schools. Benjamin (1968:) lists two aspects of teaching that science teachers in Africa encounter. These are “giving notes”, and “teaching to the exam”. The two aspects according to this educator are the criteria by which good teaching is judged by African students. As argued by Parkinson (1994:134), teachers are often faced with the conflict that if pupils are left to take their own notes, it is inevitable that they will make mistake, and therefore, learn incorrect science.

The tradition of note giving consumes the time available for other student activities like practical work, peer interaction as well as teacher student interaction in learning a given lesson segment. In addition, such a practice makes the student to become dependent on the teacher as a sole source of knowledge. Besides these, the student tends to limit him/herself to reading only whatever appears in his/her notebook rather than developing a skill of searching information in either the text book, or other reference materials.

This practice again diminishes the students reading habits. Note giving may be indispensable in situations where there is shortage of textbooks for students. In areas of abundance, however, the tradition of note giving has to be used as a supplement rather than replacing other classroom activities.

Concerning the teaching to the examination, the student views a good mark as a gate way to a higher grade/schooling. According to Benjamin (1968:50), some students fail to evaluate which elements are important and which are irrelevant. Thus, the teacher needs to get the students through what appears in the syllabus. The author further points the fact that some African students go to the extent of asking the teacher if the matter under discussion appears on the exams.

As regards the problems relating to physical materials, lack of science equipments and shortage of textbooks, are among the most pressing as identified by several authors (young, 1979; Allsop, 1991). Young argues that in situations where resources are scarce, teachers often face difficulty in organizing practical activities for children. Nevertheless, competent teachers can organize different group of students to work on different activities, so that groups can exchange materials after completing the first works they were assigned to carry out.

Although scarcity of resources might be among the most common for most schools, administrative situations could also be the major obstacle to use

science equipments where available. Lack of access to the materials (equipments) is the top difficulty the teachers are often heard to complain of, especially in Ethiopian primary schools. In most schools, science teaching materials such as the science kits are kept in the store because there are no rooms where to keep these materials at the disposal of the teachers. Teachers are required to assume responsibilities to carry the kits and other materials from the store and back to it from the classroom after use. The school regulations pertaining to materials management often require teachers to replace or refund the price of lost or broken materials. Hence teachers show reluctance to use the materials for fear of accountability.

In trying to get some consumable materials and supplies, (for example, dry cell batteries, bulbs, etc), there is always a universal problem of budget to purchase. Even when there is budget allocation for purchase of these items, it is not uncommon to observe a delay in release of budgets.

These, and similar other factors always force teachers not to plan and involve students in practical activities which could lay foundations for the development of several cognitive and affective skills in the learners. Miller (1988) showed that school science is ineffective in providing scientific and technological literacy to the learners for the very reason that it lacks meaningful practical work that promotes personal involvement of the learners. Students devoid of practical work in science, Miller argues, would end up functionally illiterate in their lives (quoted by yager, 1991:25).

Science by its very nature is a subject that requires students' involvement in verbal interaction with their peers as well as the teachers. The physical arrangement of the classroom can advance or hinder this interaction (Carin & Sund, 1989:123). In most classrooms, the seating arrangement does not lend itself for flexible group work. Although the physical arrangement of the classroom can be improved in some places, the students' passivity is among the common characteristic of African students. As argued by Benjamin, the reason for the students' unresponsiveness has to do with their past experience with parents, relatives as well as teachers. Children are often intimidated for asking questions of elders in the home (Benajmin, 1968: 53). On top of this, some teachers may discourage student questioning mainly for two reasons. Some perceive it as a challenge to their authority; others avoid it due to lack of knowledge in handling the subject. It is common sense for anybody to imagine how fatal it would be to the natural curiosity of children to know something new by asking questions and seeking answers. As opposed to the discouragement by adults both in the home and the classroom, some students may not like to be questioned for lack of confidence to speak in front of the class, or being afraid of giving wrong answers. A considerable number of students would also prefer teachers to do all the work due to the tradition of dependence on the teacher for every bit of information.

According to Lorschach & Tobin (1997), many students expect control and guidance and believe teachers to be the experts whose knowledge is to

transfer the knowledge to the students' mind much like one fills a bottle with liquid. If teachers fail to fulfill their traditional roles, students might get confused and find it difficult to engage in activities as intended by the teachers. Thus, the authors suggest that teachers should also assume responsibility in educating students to be effective learners by teaching them how to learn.

Other possible reasons why teachers use methods that encourage student passivity are identified by Clive Carr'e (1981). Some of these are summarized below.

1. 1. There is respectability in the transmission doctrine among teachers: - those teachers, who have been recipient of knowledge through lecture, tend to do same for their students.
2. A transmission mode:- enables the teacher to have a tight hold of the reins and to know what is going on in the classroom.
3. Shortage of time:- teachers rush to cover the content very quickly as examinations pose demands on what happens in the lesson (in Bentley and Watts, 1989:7).

Tobin and Gallanher's findings in a case study also showed that one of the teacher's priorities was content coverage which stood against the assertion that the role of the teacher is to mediate the learning of the student. As these authors continue to report, teachers in the observed science classrooms "changed topics at the scheduled time regardless of the extent to which

students had learned what had been covered” (Tobin, et al in Dorothy L.Gabel, 1994:49).

2.4 Role of Activity Oriented Science

Actively engaging students in hands-on and minds-on science is the goal of most science education reform. This goal can be reached when students are given opportunities to experience, reflect on their experiences in relation to what they already know, and resolve any problems that arise in their effort to form new understanding.

Students need time and be given opportunities to manipulate materials make observations, describe and make sense of what they learn, negotiate meaning by comparing points of views of others and their personal meanings of concepts through cooperative learning groups, as well as whole class discussions (Lorsbach & Tobin, 1997). Activity oriented science emphasizes the development of the 3 Hs (the head, the hands, and the heart) of an individual (Obanya, 1985), and therefore, aims at the acquisition of intellectual, physical as well as social skills in the learners.

Qualter& associates, in their book entitled *Exploration: A way of learning science*, view that explorations play vital role in children's learning by stimulating interest and allowing practice of practical skills. Furthermore, understanding of science is also believed to be constructed by the learners as they get involved in actually applying scientific concepts and process in

solving problems. For these authors, exploration promotes active learning in which both mental and physical activities are combined so as to lay a firm foundation for cognitive outcomes through first hand experience (Qualter, et al (1990:19-20). It is also well argued by constructivists that science education should be concerned with the application of ideas rather than the ideas themselves, because students comprehend a concept in action than an abstract concept presented to them only through words.

Hands-on activities, according to Orion (1993), facilitate the acquisition of abstract concepts and promote meaningful learning in science. Furthermore, the value of learning through such activities is well documented by the Lawrence Hall of Science at the University of California (1995) as under.

Hands on learning:

- increases learning and achievement in science and mathematics content
- increases skill proficiency in the process of science and mathematics, such as graphing and interpreting data.
- improves skills and attitude towards math and science helps the development of communication skills
- encourages student creativity in problem solving and also promotes independent thinking skills
- helps academically weak students gain greatly from activity based programs.

In general, the learning of science through a variety of hands-on, minds-on activities serves a number of implicit and explicit goals. It may help to contribute to learning in other areas, to the development of positive interpersonal relationships among the students and shape the attitudes of each individual toward the subject, beyond contributing to the cognitive development.

Integration of science and other subjects

Every subject in the curriculum relate to one another in different ways. The science process skills form essential components of language and mathematics and also make use of the skills from these disciplines Gega and Peter (1998) believe that science helps to meet a variety of objectives in language and mathematics areas, for every science activity calls for skills from these parts of the curriculum. When students measure and graph changes in plant growth, for example, they use mathematics, and when they organize and report their findings in experiments and observations, they use language skills such as reading and writing (Gega & Peter, 1998:21-22).

Several studies viewed cumulatively suggest that science instruction in elementary grades helps in improving reading skills of children. For instance, studies by Campbell 1972; Quinn and Kessler, 1976; Mechling and Oliver 1983, indicate that students derive benefits from science instruction in the areas of discriminating vowels and consonants, vocabulary enrichment, verbal fluency as well as enhanced ability to think logically. Involvement in activity based science programs, according to Simon and

Zimmerman (1980), provides learners with a multitude of experience to draw from when they think and write. Steve Whitworth shows how extended discussion, linked to writing, boosts the confidence and self-esteem of low achieving students. Such writing also allows them to revise and experiment ideas in science (in Bentley & Watts, 1989 59-63). Teachers can, therefore, encourage students to write by thinking out ideas in their own words, either individually or in groups by giving assignments, project works, and/or class activities consisting of hands- on or minds-on science. Billhart and Debs (1981) show that a large proportion of writing can be taught by evaluating written lab reports, by critical grading of the things that students write, and providing feedback on their writings.

Parkinson (1994:135) argues that children learn the meanings of words when they think out ideas in science and put them down in writing in their own words, than when they are required to copy from the chalk board, or take down dictation. Mechling and Oliver (1983) witness that when a teacher helps students develop science process skills, reading processes are simultaneously reinforced. They go on to assert that through science experiences, students can apply mathematics to real world problems when teachers provide hands-on science activities that facilitate the learning of abstract arithmetic concepts. In addition, science experiences enhance the operational abilities of children and also facilitate the transition from one level of cognitive stage to the next (Froit, 1976; Tipps, 1982, in Karen Ostlund).

Science learning, as concluded by Cairn and Sund (1989), helps children to develop not only mental operations, but also a greater willingness to solve problems. They further point out that one of the primary values of science activities lies in helping students solve real life problems. According to these educators, Piagetian operations such as conservation of substance, length, and number as well as ordering and classification, are basic to both science and mathematics. Involvement of students in these operational tasks helps them to overcome the problem of logic and doing things with numbers (Carin and Sund, 1989:228-229). Goodlad also shares a similar view when he says "a field observation in science leads to some other non-science activities like drawing measuring and weighing where skills in art and mathematics are applied" (Goodlad, 1973:53). The author further goes on to assert that children would get their natural curiosity sharpened with the first hand experience in science.

Curiosity, according to Lawrenz Lowery, serves an important function in helping students build crucial connections in the brain. Pieces of information, such as for example, observation of colour, form and texture of an object can be synthesized into a larger concept of an object as a result of these connections. He thus, urges educators to capitalize on curiosity in the classroom by providing the students with inquiry centered experiences, as these spark the formation of the connection in the brain (in National Science Resource Center, 1997:23).

Attitude:

One important goal of science teaching is the development of positive attitudes towards science on the part of the learners. To reach this goal, the instructional process must provide opportunities for students to experience, inquire, observe, describe their observation both in writing, and formulate their own conclusions. (Obanya, 1985; Martin, 1997).

If learners are helped to experience science through a variety of hands-on and minds-on activities that motivate them, a large pool of attitudes could be developed. UNESCO (1962) lists about 17 points that can be reinforced by science. Few of these are presented below.

1. Capacity for self-motivation and acceptance of responsibility for one's own learning.
2. Self-criticism; also a willingness to criticize and be criticized by others
3. Cooperation with others
4. Open mindedness - willingness to change one's mind in the light of new evidences.
5. Willingness to speculate and take intellectual risks
6. Enthusiasm for science
7. Capacity to resist claims unsupported by evidence or theory
8. Application of science problem solving skills to every day situation.
9. Perseverance and tenacity in the face of difficulties (UNESCO, 1962:106).

Socialization:

One of the primary purposes of the school is the development of positive social relationships among students in addition to shaping the student attitude toward the school activities and subjects. Being one of the core subjects of the school, science activities promote these goals whenever activities in a group situation, according to Bentley and Watts, 1992:57) would enable students to explore the understandings of others and to shape individuals, misconceptions through talking listening writing and experimenting. In so doing, children learn tolerance to views of peers and develop courtesy towards others. Besides these interpersonal developments, activities in science also play prominent role in shaping behaviors of individuals as group norms may impose conformity to common purpose. Martin et al (1997:45) assert that children who are socially maladjusted tend to do better in schools when they are assigned to work in groups. A number of interpersonal skills could be reinforced when students are allowed to engage in small group activities. Sunal and Sunal (2002), provide four important goals that cooperative learning fosters for students. Three of these goals include:

1. Positive interdependence among students _ students know they are all relying on each other for a successful outcome to each experience. They learn to work together for the common good. Their discussions,

explanations, questions and other verbal exchanges, play an important role in sharing, applying and reviewing the contents.

2. Individual accountability for group learning - positive student interaction promotes the use of group pressure to change a disruptive behavior of an individual and forces him/her to hold accountable for their learning.
3. Group processing - students are encouraged to discuss how well the group accomplished its goals, and to evaluate individual roles in the group (Sunal and Sunal, 2002).

Proponents of cooperative learning methods, such as Roger Johnson and David Johnson (1991) as well as Robert Slavin (1995) hold the view that cooperative learning has several advantages to serve: students learn more science, like the subject more, and feel more positive about their performance if more of their science experiences were gained through cooperative learning (in Martin et al, 1997:328).

Effective group integration results in the development of highest level cognitive skills of evaluation and synthesis in all members because each individual member has something to contribute to the group. Students are also free, and encouraged to ask questions of their peers so that they could get more understanding of a concept than they do in whole class situations. Several authors also believe that students of less academic ability are more attracted in to the discussion, and by so doing, they are likely to improve

their skills of analysis, synthesis and reasoning (Moench, 1986, Carin and Sund, 1989).

Questions raised at whole class level either by the teacher, or a student also have important value of developing the students' thinking skills. Particularly questions of higher order cognitive level are essential component of inquiry and discovery in science. Redfield and Rousseau's (1981) meta-analysis of experimental research on teacher questioning behavior, indicate that higher cognitive questions have greater effect on student achievement than lower cognitive ones. An instructional practice in which teachers raise open-ended questions also draws a number of students into discussion including students of lower academic ability because all answers are acceptable, and teachers do not stress the right answer as they usually do with close ended questions which usually have only one answer. Open ended questions do also pave way for students to ask their own questions which also set a new direction to find out the answers and develop their own conclusions (Martin, 1997:196).

Other area of research on questioning dealt with the length of wait time. It is generally agreed by researchers that wait times having long duration (3-5 seconds, or more), help students to increase the length of their response and also provide alternative answers to a single question (Rowe, 1974; Tobin, 1980; Tobin, 1984). Wait-times of prolonged duration put students at ease of critical thinking and weighing alternative responses. Other students could

also get chance to think and challenge the idea of the preceding respondent, or give more critical arguments.

2.5 What the Research Says About Activity Oriented Science Teaching

Almost all of the research works surveyed were more of experimental studies, and concerned with the value of activity oriented teaching/learning relating to students' attitudes and performance in science. For example, the study by Staines (1956:97-111) showed that classroom atmosphere and more specifically, teacher comments in interaction with students, had a profound effect on student self-concept. Shymansky, et al (1974) found that the teacher's classroom behavior in an activity centered science program provided significant changes in the way children perceived themselves when dealing with science activities. When teachers exhibited highly directive and evaluative behaviors, students generally assumed very dependent roles in problem solving situations involving science materials and activities. Classrooms in which the teacher exhibited non-directive and non-evaluative behavior appear to cause students to become more independent and activity oriented in the science problem situations.

A study of student classroom behavior relating to problem solving, conducted by Shymansky et al (1977), showed that primary grade students who viewed themselves as self-reliant when it came to dealing with science related problems appeared to observe the teacher and other students less,

and tended to do fewer activities in which they followed the teacher's directions.

Bredderman's (1983) study on the effects of activity based elementary science on student outcomes produced that students in process approach programs learn more than do students in traditional textbook based programs. The research indicated that the process approach programs were more effective in raising student performance and attitudes than the traditional reading based programs.

Data from meta-analyses by Shymansky et.al (1983) on student performance across the activity based programs such as the Elementary Science Study and Science Curriculum Improvement Study, show that students in the hands-on programs out performed their traditional elementary school counter parts by 9 percentile points. In addition, this study shows that students' perceptions of these science programs as well as performance on process skill measures exceeded traditional students by 17 and 19 percentile points respectively.

Padilla, et al (1983) studied the relationship between science process skills and formal thinking abilities of middle and high school students. The study indicted that science process skill ability is strongly associated with logical

thinking skill, and therefore was assumed to be a factor that has direct influence on it.

In an attempt to compare the effectiveness of two instructional modes, discovery and expository, for teaching science knowledge in Egyptian fifth grade classroom, Ahmed Selim and Shrigley (1983) study revealed that, the fifth grade students taught by the discovery method scored higher in science achievement, than students taught by the expository method. This study further indicates that students taught by the discovery method scored higher in science attitude than their expository counterparts.

As shown by Abraham (1976), The quality of interaction in classroom groups depends on whether the teacher chooses to use homogenous or heterogeneous groupings of student. However, Lawrey and Munch (1984) found that there was no significant difference in terms of achievement between classes of homogenous and heterogeneous laboratory groups at 0.05 level.

A study conducted by Howe & Durr (1982), which used concrete manipulative materials and peer interaction as experimental treatment, indicated that the treatments enhanced the learning of two chemistry concepts for both formal and non formal operational students as compared

to the control class groups. It is also reported that both cognitive and affective outcomes were positive in the experimental class groups.

Shinde's (1982) study of non-formal science activities in secondary schools with respect to their impact on scientific attitude and achievement in science on a sample of 1600 randomly selected students showed that field observations, activity participation, and activity independence of the students were related to one another.

A comparative study of the effectiveness of open-ended approach of doing physics experiments versus traditional approach at higher secondary stage, by Gangoli, & Gurmurthy (1985), India, indicated that the guided open-ended group showed better performance in the achievement test and in the skill test than those of the traditional group. It is also reported by same study that within the experimental as well as control groups, high intelligent and high creativity students differed markedly from students of low intelligence and low creativity. The conclusion reached was that the guided open-ended approach was superior to the traditional approach in developing content matter and practical skills in physics.

All these studies suggest that teaching science through the use of activities has several advantages in promoting the development of positive self-concept, positive attitude towards science as well as raising student

performance in science. Furthermore, students' problem- solving and logical thinking abilities would be enhanced. Therefore, it is important that science teachers at all levels, as much as possible stress students' engagement in activities in learning science.

CHAPTER THREE

THE RESEARCH DESIGN AND METHODOLOGY

3.1 The Research Design

The study is a descriptive survey research whereby data collected through various instruments are presented, analyzed and interpreted using both quantitative and qualitative techniques of analysis. The study aimed at assessing if the suggested teaching methods of the basic science syllabus allow student involvement in learning activities. In addition, it sets out to check whether the primary science teachers plan and implement activity-oriented lessons that promote student participation in various learning activities. It also tries to see whether or not the planned activities are achieved in the instructional practice.

3.2 Sources of Data

The data for the study were secured from various sources by using appropriate instrument designed for each of the sources. The basic science syllabus for grade five, the daily lesson plans prepared by teachers, the grade five science classrooms in the sample schools and the science teachers in these schools at the specified grade level provided the necessary data. The grade five basic science syllabus which is currently being used in the primary schools of Oromia was analyzed for the presence of activities that promote students' involvement in learning the specified content and /or process of science. Of the parts of the syllabus, the section dealing with

“teaching methods” was thoroughly analyzed and the suggested methods were coded using a specifically designed coding sheet (see Appendix C).

The daily lesson plans prepared for 18 lessons by nine grade five science teachers from nine different schools were analyzed using a lesson plan analysis form specifically designed for this study. This analysis was conducted to get information on the kind of objectives set by these teachers and the kinds of teacher and student activities selected to achieve the objectives.

Nine grade five classrooms from nine different schools belonging to four Woredas of Jimma zone were selected, and observed during science lessons. Two classroom observations were conducted over two semesters for each of the classes (schools). The first observation was conducted towards the end of the first semester, and the second was held in the third and fourth weeks towards the beginning of the second semester. The two observation sessions were preferred to see if there was any change in the pattern of the classroom instructional practices. It was also thought that a single classroom observation would not provide a clear picture of the usual practice due to the fact that the nature of the topic may affect the type of active student involvement in some learning tasks.

Five out of the nine observed teachers were made to supply additional information through interview. The interview was conducted after the second classroom observation was completed. It was deliberately put to the end of

the observation session, because there was an assumption that the classroom activities would change from what normally appears if the teachers knew the essence of the questions presented in the interview. All the teachers volunteered for the interview, but as far as the responses provided by the five teachers were similar, it was believed that dealing with all the teachers is a waste of effort. Thus, the responses of the five interviews were adequate to represent all the rest.

3.3 Sampling

There are twelve woredas in Jimma zone with a total of 166 primary schools having grades 5-8. Of these woredas, those which have transport access were selected using cluster sampling technique. Thus, Nadda, Kersa, Manna, and Gomma woredas were included in the sample for they meet these criteria. From among the schools found in these woredas those that are located near main roads were again chosen as population by following the same sampling procedure mentioned above. The names of the accessible schools in each of the woredas were written on pieces of papers and then lots were drawn to randomly select the samples. Accordingly, nine schools were selected to serve as sample by using simple random sampling technique. The sample schools are

Table 1- List of Sample Classrooms by Schools and Woredas

Zone	Woreda	Total Number of accessible schools	Sample Schools	Grade and section	Class size	Location	
Jima	1.Gomma	10	Agaro-	5A	76	Urban	
			Gembe	5B	78	Rural	
			Kujo	5A	63	Rural	
	2- Manna	5	Yebu	5B	81	Rural	
			Garuku	5C	82	Rural	
			3- Kersa	10	Ginjo	5C	54
				Jiren	5B	66	Urban
				Mendera	5G	64	Urban
		4- Nadda	4	Asendabo	5D	82	Rural

Presented in Table 1. From each sample school, one section of grade five classrooms was randomly selected by drawing lots. The sample classrooms thus selected were observed twice over the two semesters as indicated earlier. The first classroom observation was held three weeks before the first semester examination started. The second one was held in the third and fourth weeks at the beginning of the second semester. Prior to each classroom observation, the daily lesson plans prepared by the science

teachers for the days' lessons were analyzed immediately before classes were to start.

3.4 Instruments of Data Collection

The following instruments were employed to collect data from the various sources:

1. 1.A coding sheet for activity analysis in the grade five basic science syllabus
2. A lesson plan analysis form
3. A classroom observation checklist, and
4. Interview

A coding sheet designed for activity analysis in the grade five basic science syllabus was used to provide data on the kinds and frequencies of the suggested methods that allow student involvement (participation) in learning the prescribed content. The information about these suggested methods were classified into three major areas (categories) of activities as discussion, recording and experiment. The data obtained through this mechanism was used to calculate the intended student participation index, along the three categories and to compare it with the actual index of participation gathered through the classroom observation. It was also used to see whether the prescribed methods were employed by the teachers as intended.

The reliability of the coding sheet was checked by using Krippendorff's(1980) formula and a reliability coefficient of .85 was obtained.

A lesson plan analysis form was specifically designed for this study, following the work of Gansneder, et al (1979). This analysis form helped to register the instructional objectives set by the science teachers in the specified sample schools. The objectives were then classified into three, following Bloom, et al (1956) taxonomy of educational objectives. Those objectives belonging to the cognitive and affective domains were further classified into sub taxonomic levels, while those belonging to the psychomotor domain were treated at a general level (ignoring the sub taxonomic levels). The objectives, in addition to their classification into the taxonomic levels of domains, were also classified into categories of activities they were intended to be achieved through. In a similar manner, the activities selected by the teachers to achieve the set objectives were also registered in the appropriate column of the lesson plan analysis form, which then were classified into the three general categories of activities (Discussion, Recording and Experiment). The frequencies of the objectives and the activities were counted and then tabulated to serve as object of analysis in chapter four of this study.

A science classroom observation checklist used in this study was adapted from the work of Dorothy J. Alexander (1974). The observation checklist consisted of 12 varieties of traditional science classroom activities that could be classified into the three major categories such as discussion, recording and experiment. The varieties included both teacher and student activities that could be coded by an observer. The checklist was believed to direct the attention of the observer in coding the kinds of the classroom activities in a

systematic manner. The use of this checklist, therefore, helps to avoid subjective judgment by the observer while coding the teaching/learning activities during the actual instructional practice. The systematic nature of the checklist enables any observer who is not necessarily trained for any sophisticated use of observation techniques. It also provides for easy and immediate recording to be made following each classroom behavior within a predetermined time length. In this study, the activities that took place during each lesson period were coded after each 15 seconds, providing a total of 160 tallies for every 40 minutes lesson. The tallies obtained this way provided the frequencies of the observed activities.

Unstructured interview consisting of nine questions was conducted, with five teachers from among the nine, whose classrooms were observed. The number of the interviewee was limited to only five although all the nine volunteered, because the responses provided to the questions were almost similar. During the interview the questions were raised to the respondents, and then their responses were followed by probe where it deemed necessary. The results of the interview helped to identify the reasons why the instructional activities went the way they were observed in the classrooms.

3.5 Techniques of Data Analysis

The data obtained through the specified tools were tallied and the frequencies were tabulated and presented following each research question. Percentage calculations and chi-square test were employed to analyze the

quantitative data, while descriptive narrative was used to analyze the interview as well as some qualitative aspects of the observed classrooms. Participation index was also calculated for each classroom to estimate the level of student involvement along the three major categories of activities. Overall index of participation was also used to judge whether the classroom instructional practices were teacher, or student dominated.

CHAPTER FOUR

PRESENTATION, ANALYSIS AND INTER PRETATION OF THE DATA

4.1 The Aims of Science Syllabus

The broad aim of the grade five basic science syllabus designed for Oromia Region was the development of some understanding of human body functions, their physical and biological environment, and interpersonal relationships. Skills and attitudes important for the well being of human beings and their environments and the development of problem solving and critical thinking abilities is also another aim to be attained by the teaching of the subject to the specified target groups. More specifically the science experiences were aimed at:

1. Understanding the functions of the various systems of the human body

2. Developing awareness on causes and transmission of some diseases, and on how to protect themselves and others against these diseases.
3. Developing understanding in plant and animal reproduction.
4. Developing the spirit of participating willingly in the protection of the natural resources.
5. Developing scientific and technological skills of problem solving critical thinking and the skill of expressing ideas clearly.
6. Developing understanding of the sources and mechanisms of energy transfer (heat, light, electricity).

Based on these general aims, appropriate contents were selected, and teaching methods believed to facilitate the acquisition of the content were also suggested in the syllabus.

This content analysis of the syllabus is conducted just to determine the extent to which the suggested methods/activities are encouraging student involvement in various learning tasks.

There were 14 different kinds of teaching/learning methods suggested in the grade five basic science syllabus currently being used in primary schools of Oromia. These methods were classified into three major categories. Table 2 shows these general categories. Student drawing, field observation and reporting, as well as student assignments were grouped under category named “Recording”. The second category called “Experiment

(practical work) consists mainly of student experiments, project work and teacher demonstration. The third major category comprises of teacher's lecture, guest speaker, whole class discussion and small group discussion, and was termed "Discussion".

To estimate whether the suggested methods are student or teacher dominated, each of the categories were given weights ranging from 1 up to 3. If the suggested method was believed to be teacher dominated, a weight 1 is assigned. If, however, the method is thought to promote equal involvement of both the teacher and the students, weight 2 was assigned. Finally, for those methods, which promote maximum student involvement with minimum or no teacher involvement weight 3, was assigned.

Accordingly each activity was multiplied with its respective weight and added together, which then was divided by the total frequency of the general category to get the student involvement index. If the calculated index was 2.0, then it is said that the method promotes equal teacher and student involvement. An index falling below 2.0 designates that the method is more teacher dominated. If the index is exactly 1.0 it is said to be totally teacher dominated indicating that students made no participation other than listening or watching. On the contrary however, if it is exactly 3.0 we can judge that the method is totally student dominated. In general, a slight rise above 2.0 would mean that student involvement is higher when using the suggested method, while on the other hand, a slight decrease below 2.0 means that teacher domination is increasing, i.e. less student involvement.

Recording

A close study of Table 2 shows that, of the suggested methods/activities, discussion takes the lion's share by percentage while writing or recording activity seems to be relatively less favored. However, as almost all of the suggested recording activities are believed to be carried out by the students themselves with minimum teacher involvement, this category is the most student dominated as compared to the rest two.

Another indicator supporting this assertion is the student involvement index. As can be observed in Appendix F recording/ writing is the only category of activities where student involvement index is the highest. This is the only category where the index rises above 2.0. Over seventy percent of these activities require students' out of class study such as for example, field observation and reporting, preparation of reports on project works conducted by students, by consulting resource persons in the community. Such activities do have dual advantage to the learners. On one hand, it arouses their interest in the work and it also helps them relate classroom instruction to the outside environment where they live. Thus, the potential for students to draw direct relevance out of their learning to their daily life is immense. Such classroom and environment linkage through student involvement in these learning tasks also paves way for drawing community resources and expertise of various professionals to support school's academic activities. It also raises the awareness of these professionals (health and agriculture) of the role they could play in education.

One other subcategory of the recording activity is students drawing, where they apply skill from arts lesson to their learning in science. This accounts for over sixteen percent (16.7%) of the students' activities within the recording category though it appears to be very small when weighed against all other activities suggested in the syllabus.

Whenever students are let to engage in out of class activities it can be claimed that they would develop better self-reliance together with several skills of enquiring, recording and reporting. Once mastered skills of any sort are well retained and continue to improve with practice (Fitts and Posner, 1967). In addition, students would be put at ease and learn at their own speed individually by evaluating evidence from variety of points. Besides these, such learning activity would save more time for other classroom learning tasks (activities).

Despite these positive advantages, the various activities of the recording category are not common to all the lesson units. For example, field observation and reporting is limited to units one, two, eight, ten and eleven; student drawing/design as well as project report appear in units one, two, three, five, six, seven and eleven. The frequency with which these activities occur in those units is also very small except that field observation and recording has a frequency of 3-5 in the first and last units. The discontinuity in the practice of these skills might affect the attention of teachers in assigning students to undertake these tasks.

Table 2 Suggested Teaching methods and their category by areas of Activities

		III f %	II f %	I f %	Total f %	Percentage within Category F %
Recording	Student drawing/ design	2(1.4)	1 (0.7)	-	3(2.1)	3(16.7)
	Teacher drawing	-	-	1 (0.7)	1(0.7)	1(5.6)
	Field observation and reporting	9 (6.3)	-	-	9(6.3)	9(50)
	Project report	5(3.5)	-	-	5(3.5)	5(27.8)
Discussion	Lecture	-	-	51(35.9)	51(35.9)	51(54.3)
	Class discussion	-	25(17.6)	-	25(17.6)	25(26.6)
	Small group discussion	4(2.8)	-	-	4(2.8)	4 (4.3)

	Question and answer	-	1(0.7)	-	1(0.7)	(1.1)
	Student citing example	3(2.1)	8(5.6)	-	11(7.8)	11(11.7)
	Guest speaker	-	-	1(0.7)	1(0.7)	(1.1)
	Drama	1(0.7)	-	-	1(0.7)	(1.1)
	Project work (material)	4(2.8)	-	-	4(2.8)	4(13.3)
Experiment	Student experiment	-	9(6.3)	-	9(6.3)	9(30)
	Teacher demonstration	-	-	17(12)	17(12)	17(56.7)
	Total	28(19.7)	44(31)	70(49.3)	142(100)	

Discussion:

Discussion activities lean more to the teacher's lecture than those meant to involve students. As can be observed from Table 2, lecture consumes over thirty five percent

(35.9%) of the total activities and more than fifty four percent (54.3%) within the discussion category. The second highest activity by percentage is teacher mediated whole class discussion which receives seventeen point six (17.6%) and twenty six point six (26.6%) percent of the whole activity and the activities within the category respectively. More student directed activities such as small group discussion, question and answer, supply of examples by the students, as well as drama, account for only twelve percent across the whole pages of the syllabus and eighteen point two (18.2%) percent of discussion.

Overall, discussion consumes over sixty-six percent (66.2%) of the total teaching learning activities. Paradoxically however it takes the least position as measured by the student involvement index (see Appendix F) This would suggest that little time is spared for teacher-student and student-student interaction. Such denial of opportunities for students to get actively involved in discussion would suppress their feelings for social interaction. The goals and the rules of the game are fuzzy and blurred in that the suggested discussion activities stand in direct contradiction with the general objectives of the syllabus such as for example, “development of critical thinking” abilities and “expression of ideas clearly”. If appropriate emphasis could be rendered to student interaction it is evident that students’ beliefs and existing misconceptions can be corrected by sharing meaning both with the teacher and their peers. Unless students are given chance to interact, little conceptual change takes place from the classroom transaction. Gunstone and Champagne (1990) argue that discussion is necessary if not sufficient condition for conceptual change to come true (in Elizabeth Hegarty-Hazel, 1990: 179-180).

Undervaluing oral interaction in science limits the relevance of the content to the life of the student and goes to the extent of distorting their interest of enquiring. As a result rote memorization rather than critical evaluation of ideas becomes the sole method of learning. Thus, a student brought up silent in the class would continue timid and shy throughout his/her school life.

Experiment:

Experiment as a major category of activities in this analysis constitutes teacher demonstration, student experiment, and project work that involve students in some hands-on activities.

Practical work (student experiment) often focus on set procedures and exercises, and there exists no open ended student formulated activities except that some project works require the formulation of design and production of some material objects individually at home. This work accounts for less than three percent of the total activities suggested while guided student experiment is only 6.3 %. In general student experimental activities whether free-ended or to be mutually conducted by the joint effort of students and the teacher, do not exceed the teacher's demonstration by percentage. Here again the student involvement index drops below 2.0 indicating that the balance of control over the experiment activities tilts towards the teacher.

Student experiments are usually conducted in groups, and therefore, provide opportunities for students to learn cooperatively. This activity has advantage of involving all students in the group, and is motivating as every member has something to contribute either in the form of arranging materials, or recording results or otherwise. Above all, student experiment gives students opportunity to appreciate the spirit of science, develop important attitudes such as honesty and readiness to admit criticisms (Friedler and Tamir,1990).

Despite this advantage however, most of the practical activities do not invite students to formulate their own design and plan experiments independently, or set new questions for further investigation.

The Syllabus gives autonomy to the teacher to show dominance over discussion and experiment activities. The more student-directed recording activity, although encouraging in its design, may not be realized unless teachers strictly follow these suggestions and assign students to work on the required activities.

4.2 Activity Analysis in the Lesson plan

The second research question was to investigate whether teachers plan and implement activity oriented lessons in science classrooms. To address this question, a lesson plan analysis form and classroom observation check-lists were designed following the works of Gansneder, et.al (1979), for the lesson plan analysis form, and Dorothy J.Alexander (1974) for classroom observation check-list.

The purpose of the lesson plan is to give the teacher a frame work of what he/she is going to teach in an attempt to attain the objectives of the lesson topic. Serving as a brief guideline, the lesson plan is believed to contain different items. The format could vary depending on the subject, or person who writes the plan, but the most common items may include the title, the date, time of the lesson activities, the grade level and subject, list of equipments and/or resources to be used (often termed as teaching aids). It should also indicate the objectives of the lesson, the instructional procedures to be used, and teacher and student activities during the lesson. These activities need to clearly indicate what the teacher and the students are going to do at various times of the instructional process. Therefore, the lesson plan should cater for all students so as to actively involve them in the learning process. Prior to writing their daily lesson plans, teachers need to ask themselves some questions relating to student involvement in some learning tasks.

- What is the objective of the lesson topic?
- In what ways can it be taught to, or learnt by students?
- What can be discussed or how can students engage in discussing the major themes of the topic? What kind of questions should be raised as a spring board for student discussion? (Close or open ended?)
- What will children need to do in order that they best understand what they have discussed? This relates to some practical works the students actively participate in, leading to conceptual understanding of the principles and theories already discussed or going to be learnt immediately after.
- What can students write in order to store information for later retrieval? Or what should they write in order to reinforce their learning? These questions remind the

teacher as to what type of class work or home assignments/exercises should be selected for students to work on.

- What resources are needed to ensure pupil participation in various learning activities (through discussion, experimenting and/or writing)?
- Having this frame of reference, the study set out to analyze the lesson plans of teachers in the sample schools in terms of the objectives set, and the activities selected to attain them.

Objectives

Daily lesson plans prepared by nine primary science teachers for 18 lessons in nine grade five classrooms drawn from different schools of Jimma zone were observed immediately before the planned lessons were executed in the classrooms. The purpose of this work was to see whether teachers plan activity oriented lessons for their science classes. As it is believed by the researcher that the basis for selection of activities is the instructional objectives set by the teachers, and that the cognitive demands of activities depend on the taxonomic levels of the objectives, the lesson plans were analyzed for the taxonomic levels of objectives and the resulting teacher and student activities at an attempt to attain the prescribed objectives.

The nine teachers selected a total of 65 instructional objectives for the 18 lessons. This represented an average of seven objectives per teacher, or 3-4 objectives per lesson. All the instructional objectives were stated in terms of student's overt behavior, and all were in line with those implied in the syllabus. When these objectives were categorized into the

Bloom's Taxonomy of Educational objectives, 48 were in the cognitive category, while 8 and 9 were in the affective and psychomotor domains respectively.

Most of the stated objectives (about 74%) are in the cognitive domain; over 12% were in the affective domain, while less than 14% were in the psychomotor.

Sixty-five percent of the cognitive objectives were at the lower two levels of knowledge (33.3%) and comprehension (31.3). the rest thirty-five percent belong to either application or analysis levels, which in this study are categorized as high cognitive levels. No objectives were stated at the level of synthesis and/or evaluation. Among the affective objectives, receiving and responding (e.g. "lists the bad effect of drinking alcohol, Tells the protective measures to be taken to care for the lungs and other organs of the respiratory system) account for over sixty-two (62%) percent. While there were no affective objectives stated at the level of organization or value complex, which are the highest levels of this domain, those meant for the initial development of valuing such as for example, "takes measures against the development of some respiratory diseases by avoiding smoking", "Takes care for some simple machines used at home", receive over thirty-seven percent within the affective category.

The psychomotor objectives focused on the development of simple skills (eg "Measures the distance of load and effort from the fulcrum", "categorizes objects into fixed and movable pulleys"; "draws and labels the parts of the human nervous system"; Groups materials into their respective orders of levers").

With the exception of the objectives categorized as affective, which are related more towards attitudes to be developed over time, the cognitive and psychomotor domains require some overt student behaviors for their realization. Most of the stated cognitive and psychomotor objectives called for low-level operations. Teachers who set their objectives at low-level operations tend to opt for instructional methods that limit student interaction (Gansneder, et al (1979). Harris and Bessent (1969) claim that lower level objectives can be achieved without active student involvement. Conversely, it is assumed by the researcher that those who stated their objectives at higher cognitive levels would promote maximum student involvement (participation) in the classroom instructional transaction through various activities such as discussion, writing and experiment (practical work). This, in turn, forces teachers to select appropriate activities for students to engage in, so as to prove the attainment of the stated instructional objectives.

Activities

In addition to classifying the objectives into the different taxonomic levels, attempt was also made to categorize them into three broad areas of classroom activities like discussion, recording and experiment. Table 3 shows the general category of objectives by area of activities and taxonomy. As depicted in the table, over fifty-three percent of the total objectives set by teachers catered for student discussion (cognitive 46.2%, Affective 6.2% and Psychomotor 1.5%). About 29.2 % of the objectives were intended to be achieved through student recording and 12.3% call for experiment (practical work) to be undertaken if the objectives were to come true. Three out of the sixty-five objectives were difficult to classify under any of the three broad areas of activities, and therefore, were labeled “not

clear”. These account for about 4.6% of the total activities, and belong to the affective domain. The highest psychomotor activities are in the recording area while those for cognitive and affective are in the discussion area.

Table 3 Categories of Objectives by Specific taxonomic levels and implied areas of activities

C	Taxonomy and specific levels of objectives
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a t t e n d e n c e o f	Cognitive						Affective					Psychomotor	T o t a l
	Knowledge	Comprehension	Application	Analysis	Synthesis	evaluation	Receiving	Responding	Valuing	Origination	Value complex		
Discussion	11 (16.9)	8 (17.27)	5 (9.7)	6 (9.2)	- (-)	- (-)	1 (1.5)	3 (4.6)	- (-)	- (-)	- (-)	1 (1.5)	3 5 (3.9)

As this analysis of the objective-activity interaction shows, teachers give more priority to discussion followed by some emphasis placed on recording. Almost one-fifth as much discussion was left for experiment which is least emphasized by the teachers right from the formulation of instructional objectives. Although discussion is an activity of high priority, the manner of student involvement in it, whether teacher-student, student-student, or small group or whole class discussion was not easy to identify as there is no word or phrase indicating such specification. The most common terms used to indicate the objective- discussion pairs included words such as ‘tells’, ‘explains’, and ‘defines’, all of which call for low level cognitive activities. Despite the lowness of the taxonomic levels, however the planned discussion would undoubtedly help to break student passivity if the intended work is implemented directly in the instructional practice.

Teachers used a higher proportion of psychomotor objectives to accomplish experiment activities than affective ones. Similarly, they used more of cognitive and affective than psychomotor objectives to realize discussion. More than half psychomotor objectives focus on recording activity for their attainment. While teachers emphasized more recording activity in the cognitive than the psychomotor objectives, there wasn't any affective objective to be attained through recording.

Further examination of the lesson plans for teacher selected classroom activities led to the kinds of teacher and student activities sought to attain the stated instructional objectives. Under the “activities” column set for teachers and students, there were a total of 103

teacher activities and 110 student activities in the 18 lesson plans. The kinds of activities for the two groups are presented in figure 1.

Fig 1 Kinds of Teachers and student activities observed in the lesson plans

Teacher activities	Student activities
<ul style="list-style-type: none"> • Revising past lesson • Lecturing on the new topic • Leading class discussion • Asking questions to check for understanding • Giving explanations • Giving written class work • Giving notes on the main points • Answering student questions • Demonstration • Summarizing the lesson orally 	<ul style="list-style-type: none"> • Listening • Reading aloud • Participating in whole class discussion • Group discussion • Oral presentation • Ask questions • Answering questions • Doing written class work exercises • Taking notes on the main points • Drawing • Watching demonstrations • Experimenting

As figure 1 reports, there are different kinds of teacher and student activities commonly used by the nine primary science teachers who submitted their lesson plans to meet the objective of this study. There are 10 varieties of teacher activities and 12 student activities. In almost all the teachers' plans, for every teacher activity, there exists a

corresponding student activity showing that there is a fifty-fifty relationship between the two parties. If this continues to happen in the instructional practice, a sort of teacher-student domination would occur than either teacher-centered, or student-centeredness. The appearance in the lesson plans, of such a balanced relationship, however, does not guarantee the likelihood of teacher-student co-domination in the actual teaching learning process as this may be affected by some other factors.

Once the kinds of student activities are known, the question that needs to be answered is, which of these activities do teachers emphasize more?. This depends on the frequency of each activity in the lesson plans. Table 4 displays the planned frequencies of student activities by general categories of discussion, recording and experiment. As the data in table 4 reveals, sixty-one out of the total one hundred ten frequencies of student activities (i.e, 55.47%) focus on discussion. Recording work receives a second place by priority order, while experiment is least emphasized.

Table 4 Planned frequencies of student activity

	<i>Kinds of student activities</i>	<i>f</i>	<i>%</i>	<i>Percentage within category</i>
Discussion	1.1 Group discussion	1	0.91	1.6
	1.2 Whole class discussion			
	1.3 Asking and answering question	13	11.82	21.3
	1.4 Oral presentation	43	39.10	70.5
	1.5 Reading aloud			
		2	1.82	3.3
		2	1.82	3.3
	Sub total	61	55.47	100
Recording	2.1 Taking notes	15	13.64	71.4
	2.2 Doing written class works	3	2.72	14.3
	2.3 Drawing	3	2.72	14.3
	Subtotal	21	19.08	100

Experiment	3.1 Watching demonstrations	8	7.27	80.0
	3.2 Experimenting	2	1.82	20.0
	Subtotal	10	9.09	100
	4 Listening	18	16.35	
	Total	110	100	

More than half of the planned student activities belong to the discussion category. Within this category asking and answering questions accounted for 70.5%. Whole class discussion follows by 21.3% of the discussion activities. The rest 8.2 % consisted of group discussion oral presentation and reading aloud. Teachers gave least emphasis to group discussion as compared to other kinds of student talk activities. Although very little in magnitude, oral presentation, and reading aloud received equal emphasis. Taking notes, and watching demonstrations are the most emphasized recording, and experiment activities respectively, as compared to ‘doing written class works,’ ‘drawing’ and ‘experimenting’. These three activities, together with “group discussion”, “oral presentation” and “reading aloud”, required few student involvements and thus less emphasized.

The three activities of top priority each from the discussion, recording and experiment areas, required students to remain in their seats over most of the class time.

Another activity which is selected by the teachers to account for over sixteen percent share of the students' classroom learning mechanism, but which entirely puts the students in their seats is the 'listening' activity. Because there was no overt student behavior associated with listening, it was difficult to classify this activity under any of the three major categories of the instructional procedure. Thus, the activity is treated separately as a distinct category. There was also no instructional objective set by any of the teachers to achieve through student listening activity.

One hypothesis that could be advanced as a major reason for stressing the use of those student activities of top priority (question and answer, taking notes, and watching experiments), together with listening, is that the class room discipline is well maintained when students continue working in their seats as the teacher holds the rein of the class. Specifically, however, why teachers emphasized student questioning and answering may be that, it is the easiest method of obtaining student participation in discussion. Secondly, it could be that the method serves as a means of getting students' attention for the topic under discussion.

Taking notes might be perceived by the teachers as the only means for students to retain the main points of what has been discussed in the class for later memorization. Watching demonstrations at the expense of student experiment , might have been preferred by the teachers to over come the scarcity of material resources, and buy time for other class room activities. Whatever the reason, this study points out that these teachers consider these student activities as most important to achieve their stated instructional objectives. It

should also be noted that none of the activities in any of the general categories is open ended as corresponding teacher's activities exist in the background to monitor that of the students at every point.

In an attempt at checking the relationship between the planned activities and the objectives that laid their foundation, the data obtained on the objectives and the student activities was subjected to chi-square test. The calculated chi-square value (4.3907) was less than the critical value (5.99). Therefore, there is no significant difference between the objectives set and the activities planned to attain them. The selected student activities are, thus, mirror images of the objectives sought by the teachers.

4.3 Use of the observation check list

A twelve (12) category system of traditional science classroom activities based on Alexander's (1974) *Observation Schedule* was adapted to this study with some modification. The various activities were then classified into three major categories as: Discussion, Recording (writing) and Experiment. Reliability of the check-list was checked in five classrooms before it was used for coding the usable classroom activities. Two observers sat in the back corners of the pilot classes and coded the activities and their time lengths every 15 seconds which provided a maximum of 160 tallies over the whole 40 minutes period for one class. The tallies obtained this way provided the frequencies of the classroom activities.

Reliability co-efficient following Good and Brophy (1997) was calculated to check how close the two observers were in their coding activities, and reliability co-efficient of 0.88 for discussion, 0.94 for recording and 0.91 for experiment were obtained. Following this, the instrument was improved by adding an additional student activity (e.g. reading aloud from text) obtained from one of the pilot classrooms.

Using the observation checklist so improved, classroom teaching learning activities were coded in 18 classrooms drawn from nine primary schools that were selected from four woredas of Jimma Zone. The schools were randomly selected from among those having transport access. Before beginning the classroom observation, the researcher visited all the schools and permission was obtained from the directors. The teachers also volunteered for the class observation, and all were then informed when they would be observed, but did not know the purpose of the study. The observation was held in two phases. The first one was held towards the end of the first semester by making pre-arrangements with the teachers on the dates, periods and sections to be observed. The second observation was held beginning the third week of the second semester, but this time teachers were not informed the date.

The classroom observation was entirely conducted by the researcher because it was not easy to find an assistant who had free time to go to all schools with the researcher. The other reason why the researcher determined to conduct the classroom observation himself was that using different assistants for different classes would affect the reliability of the observation. Immediately after each observation, the tallies were counted and assigned

numbers I, II, or III to estimate the level of student participation in that class. Fig 2 shows the weight and key to compute students' participation.

A. Discussion

I	II	III
<p>Teacher lectures, gives explanations, asks questions.</p>	<p>Teacher asks questions of class; class gives answers to teachers questions or reacts to ideas initiated by teacher or</p>	<ul style="list-style-type: none"> - Students ask their own questions; others students provide answers to questions raised by students or react to ideas, comments explanations, etc given by students. - Students present individual or group assignments orally to the class. - Students discuss in pairs or small groups

B. Recording /Writing

I	II	III
<p>Teacher writes notes, main points of lecture, or draws graphs tables diagrams on the chalk board students watch and listen.</p>	<p>Teacher gives notes on the chalk board or dictates orally to the class; students copy notes, graphs, tables from the chalk board or text book, etc or take dictation.</p>	<p>. Students record results of practical work (experiment), draw graphs or tables of their own as individual seat work, or group work or write answers to class work exercises</p>

C.Experiment

I	II	III
<p>Teacher demonstrates to the class by using concrete materials, charts, graphs, pictures, diagrams, etc. Students listen and observe quietly.</p>	<p>Teacher gives explanations as to how to conduct experiments or carry out practical works, or couches students while doing the practical work. Students carry out, practical work following teacher's</p>	<p>Students carryout practical work or conduct experiments by following instructions from their text books (either individually or in small groups) without direct help by the teacher.</p>

Fig 2 weight and key to compute participation index.

Student participation index in each of the major categories of activities were then calculated. The student participation index for school A, during the first observation, for example, was calculated as follows (see Appendix E₁)

$$\text{Discussion} = \frac{(68 \times 1) + (41 \times 2) + (12 \times 3)}{121} = \frac{186}{121} = 1.5$$

$$\text{Recording} = \frac{(4 \times 1) + (21 \times 2) + (0 \times 3)}{25} = \frac{46}{25} = 1.8$$

$$\text{Experiment} = \frac{(14 \times 1) + (0 \times 2) + (0 \times 3)}{14} = \frac{14}{14} = 1.0$$

Over all index of participation

$$= \frac{(86 \times 1) + (62 \times 2) + (12 \times 3)}{160} = \frac{246}{160} = 1.5$$

Table 5 shows this index for each of the observed schools during the two phases. It is clear that the study of this table helps to understand the area of activity where the student participation is higher or lower. It also helps to understand if there is a change in the patterns of participation during the second observation.

Table 5 Student participation index by areas of activities and observation phases

Activities	Observation phase	<i>Schools</i>									
		A	B	C	D	E	F	G	H	I	Mean
Discussion	I	1.5	1.2	1.6	1.5	1.3	1.1	1.4	1.2	2.1	1.4
	II	1.2	1.4	1.4	1.4	1.1	1.4	1.3	1.1	1.4	1.3
Recording	I	1.8	1.6	1.7	1.0	1.7	1.9	1.7	1.8	1.6	1.6
	II	1.8	1.8	1.6	1.6	1.7	1.7	1.7	1.6	1.6	1.7
Experiment	I	1.0	0.0	1.0	0.0	0.0	1.0	0.0	1.3	0.0	0.5 (1.1*)
	II	0.0	1.4	1.0	1.3	0.0	1.4	0.0	0.0	0.0	0.6 (1.3*)
Over all		1.5	1.3	1.5	1.5	1.6	1.5	1.5	1.3	1.6	1.5

* an average mean index for the schools which conducted experiment
(practical work)

The level of student participation was usually greatest in the recording area for all the schools, except school D, which showed no student recording activity during the first phase, although there is high improvement during the second. There was a slight improvement of student participation in only two schools (B and D) and a slight decrease in three schools (C, F and H), while the rest maintained their original position. Highest student recording activity was evident in school F during the first phase and in schools A and B during the second observation. In general, the index for all the schools is improved during this phase. This seems to have occurred due to the fact that teachers emphasize note giving more than any other classroom student activities. Students also tend to consume long time in copying the notes from the chalk-board. This persistence of students on copying notes has contributed to the relative rise in their participation index during the second observation as compared to their involvement in other areas such as discussion and experiment.

Concerning discussion activity the results are very near to 1.0 in five out of the nine schools along the two phases. Only in school I, was a slightly student directed discussion activity noted, where the index for student participation rises above the overage at first, although it drastically falls by a difference of 0.7 in the second phase. A decrease in student discussion index is the characteristic of most of the schools.

Although schools B and F show rise of student discussion index from 1.2 to 1.4 and from 1.1 to 1.4 respectively, the overall discussion index tends to fall for all the schools as opposed to the pattern observed in recording. As a general rule, all the schools showed teacher dominance in the discussion area with very low student involvement.

Experiment as a science teaching learning activity is not the characteristic of all schools, and where used, it most commonly took a form of teacher demonstration. The schools which were observed using this activity also were not consistent in their work along the two phases except schools C and F. Three schools (E, G and I) maintained consistency for not using experiment. As can be observed from table 5, it is easy to judge that schools which used experiment during the second phase showed a slight improvement over their phase one counterparts, for there exists some student involvement as indicated by their mean participation index of 1.3.

While rise in student participation is evident in recording and experiment during the second observation, a decrease was noted in the discussion area. Teacher dominance is greater in experiment and discussion than it is the case for recording. In none of the classroom activities, the participation index of 2.0 which is assumed to maintain the fifty-fifty relationship of teacher student co-dominance was observed.

In general, all classroom teaching learning activities are teacher dominated with little student participation as the overall mean participation index is only 1.5. Why teachers fail to promote maximum student participation over every area of the classroom teaching learning activities remains an object of further investigation.

A study of student involvement in different learning tasks is best described by table 6 which shows the kinds of sub categories of activities grouped under discussion. Discussion category for example, contains student activities such as questioning, students' oral presentation of assignments, students' answering questions, and reading aloud from the textbook. Teacher activities on the other hand consist of lecture, explanation as well as teacher questioning.

About fifty-three (53%) percent of the total teaching learning transaction is devoted to discussion across the 18 observed classrooms. Of these, teachers' lecture, questioning, and explanation consume 37% of the class time and 70 % of discussion, while student discussion activities in the form of questioning, oral presentation, answering both students' and teacher's questions as well as reading aloud from texts, account for 15.9 % of the whole classroom activities and 30 % of discussion (compare Table 6 and Table 9). Most of the students' discussion activities are characterized by answering teachers' questions as well as reaction to teacher structured activities. This cover about 12.7% of the total classroom activities, and about

23.9% of discussion. Student-student interaction was very much limited and represents only 3.2 % of the classroom or 6.1% of discussion activities.

Within the discussion category, students' talk consumes less than one-third (30%) of the activity time, and of these the highest share goes to answering questions originated by the teachers, leaving less than 2% share to those raised by their peers. In general, asking and answering questions accounts for over 65% of the students' discussion activities. This high proportion by percentage of the total student discussion may indicate the emphasis given in the lesson plans to students' question and answer.

Reading aloud from text as a student talk activity was observed in four classrooms. Two of these classes consistently used this activity along the two observation sessions, while the rest two were found to use it during the second observation. All of these schools were urban schools belonging to two different Woredas. It was noted during the observation that many students volunteered by raising their hands to read from the text by going to the front of the class. Therefore, it can be assumed that this activity was already practiced and had become a common learning activity, that it raised the interest of those volunteers. When measured against the student talk activities, reading aloud from text consumes 21.1%. Such an activity marks a clear contribution of science teaching to language instruction. Teachers who use this method might think of it as a mechanism of making their instruction more learner-centered. This assertion can also be supported by

the fact that two of the teachers observed as using this activity also made their

Table 6. Discussion (All schools)

Activities	Observation phase	1	11	111	Total
Lecture	1	463 (30.8%)	–	–	463 (30.8)
	11	378 (25.1%)	–	–	378 (25.1)
Questioning	1	62 (4.1%)	–	29 (1.92)	91 (6.0)
	11	90 (6.0%)	–	7 (0.5)	97 (6.4)
Explanation	1	45 (3.0%)	–	–	45 (3.0%)
	11	15 (1.0%)	–	–	15
Students' oral presentation	1	–	35(2.3%)	27 (1.8)	62 (4.1)
	11	–	–	–	–
Students' answering questions	1	–	116(7.7%)	23(1.5%)	139(9.2)
	11	–	114(7.6%)	5(0.3%)	119(7.9)
Reading aloud	1	–	46(3.1%)	–	46 (3.1)
	11	–	49(3.2%)	–	49 (3.2)
Total		1053 (70%)	360(23.9%)	91(6.1%)	1504(100.00)

students to do classroom writing activities in response to class work questions presented on the chalk board. In one of these classes, it was noted that most students did not bring their texts to the class. In each of the classes using the reading activity, three to four students were made to read by coming to the front of the class and the reading activity consumed three to six minutes of the class time. For these classes the reading activity

consumed about 9.9% of their discussion session, and 3.3% of the total activities of all schools added together.

Despite the use of this activity as one variety of classroom behavior, and its role as having some motivational value to the students, the activity caters only for a small fraction of the class members. Thus, its value as promoting student participation remains questionable, for majority of the students passively listen to what is read. It can be concluded that teachers in these classrooms come to teach less prepared and they stick to student reading only to remind themselves with the main points of the day's lesson.

Another kind of student talk, which is less used as compared to other discussion activities, is students' oral presentation. This was observed in three classrooms and took two forms. In two of the classes students were made to read to the class, their answers to home assignments. In one class, however, two students were assigned to prepare on the topic of the day's lesson and taught the class like the teacher does. Their presentations were followed by questions and answers, but the activity lasted for only seven minutes. According to the teacher each student would get such an opportunity at least twice in a semester because the assignment is given every day and students are credited for doing this activity. The teacher says that, this and other similar student activities cover about 20% of their assessment in science. Though the teacher claims the activity as a daily

routine, no student oral presentation was noted in this class during the second observation session.

Discussion is the only science teaching/learning activity where more student directed activities were observed as compared to Recording and experiment, but this happened only during the first observation sessions. As can be observed from table 6, the student directed activities in the form of questioning, answering students' questions and oral presentation account for only 6.1% of discussion and 3.2% of the whole classroom activities for all schools.

The classroom discussion caters for only few students who usually ask, and take the chance of answering questions, and therefore, tends to exclude others from participation.

Teachers were found, in the observed classrooms, to make attempts at encouraging student questioning only at the end of their lessons especially towards the last five minutes. Student questioning at the mid of the teachers' lecture generally seems a violation of the classroom discipline.

Teachers' questions were observed throughout the class period and took different forms. At the beginning of the lesson, the questions usually focused at reviewing the lessons covered during the previous period. During lesson presentation, it took the form of drawing the attention of the student to the

lesson as well as mechanism of realizing their participation in the teaching learning activities. At the conclusion of the lesson, it usually takes the form of checking for understanding. In any of these forms, however, the use of open-ended questions by the teachers was not common and can be judged non-existent.

The questions asked mostly required a supply of facts, and teachers offered chances to other students only when they were dissatisfied with the answer of the first respondent.

When students asked questions, very rarely were they directed to the class and when other students responded to the questions raised by class members, there were teacher interference at many points by giving explanations and revising portions from which the questions were formulated. The reason for frequent teacher interference between student-student interaction through question and answer may be that they prefer to do away with difficult questions that could be generated from other corner of the class. Some teachers may feel less confident in handling questions that arise from topics that do not relate to their training background. Failure to answer such questions can be perceived as challenge to the teachers' authority as 'knowing everything'. The restriction of the question and answer time towards the end of the last minutes of the class can also be another indicator of such an assertion. According to Jones (2000), teachers prefer to control the classroom language, and opt for the triadic dialogue where by the

teacher asks a question, a student answers the question, and then the teacher evaluates the answer, marking the end of the dialogue.

This kind of teacher-student-teacher interaction may inhibit the students' thinking power to work out relationships and meanings for themselves because such activities mark the prevalence of low-level cognitive questions.

Lemke (1990) concludes that student debates and open-ended discussions which are some forms of student-centered oral interaction are under-used by science teachers. He goes on pointing out the behaviors exhibited by science teachers in dominating class discussion such as for example, interrupting students, pacing the lesson, controlling the topic and so on. By doing these and several other activities, teachers tend to feel they have done the best job if they have covered more material in a lesson. As one writer concludes "teachers strive for a good show well presented" (Olson,1990) when they dominate class discussion.

Teachers need to realize that students learn best when they are personally engaged and therefore, allowing students to build on their experiences through exchange of ideas with their peers and the teacher helps them to further their understanding in science. As concluded by Jones (2000), "learning science, means learning to use the language of science through opportunities to practice the talking, reading and writing of science." Therefore, it is important for the teaching-learning situation to be shaped in

a way that promotes student involvement in varieties of learning tasks so as to help them develop scientific thinking and reflecting.

Recording activity accounts for over two-fifth (42.8%) of the classroom activities of all the schools. In all the 18 lessons observed, about 66.2% of the recording task was owned by the students. Student recording took three forms: copying notes from the chalkboard, taking dictation, and writing answers to class work exercises. Doing class work exercises by writing answers was the least emphasized and was noted in two classrooms only during the first observation. For these classrooms, the activity covered 58 to 65% of the recording activities for the specific lessons which it forms a part. The magnitude, however, falls to about 4.4 to 8.8% when weighed against the frequencies of activities over the two observation sessions. Writing answers to class works is the only kind of student recording activity that required them thinking out and giving the answers to the questions. The questions required specific answers and were prepared from the lessons already covered.

The largest part of student recording activity was devoted to taking notes in the form of dictation or copying from the chalkboard, and this activity was the norm through out the 18 lessons than an exception. Excluding the share of writing answers to class works, note-taking accounts for over sixty-two percent (62.7%) of the recording activities, and about 26.8% of the total class activities. When weighed against student recording activities, taking notes consumes 94.8%.

Table 7 Recording (All schools)

Activities	Observation phase	1	11	111	Total
Teacher Writing	1	164(13.4%)	–	–	164(13.4%)
	11	254(20.8%)	–	–	254(20.8%)
Copying notes from the chalkboard	1	–	294(24.1%)	–	294(24.1%)
	11	–	426(34.9%)	–	426(34.9%)
Taking dictation	1	–	21(1.7%)	–	21(1.7%)
	11	–	20(1.7%)	–	20(1.7%)
Writing answers to class works	1	–	42(3.4%)	–	42(3.4%)
	11	–	–	–	–
Total	1 & 11	418(34.2%)	803(65.8%)	–	1221(100%)

Why teachers emphasize giving notes more than any other learning activities needs to be well investigated. But among several speculations that could be made, probably it is because teachers may perceive this work as concrete evidence of their teaching act. It could also be a way of reporting the teacher's and students' works to the school administration and parents. In the Ethiopian school supervision tradition it was common for supervisors to check students' notebooks while conducting classroom visits. Thus, teachers may frequently do this job to block supervisor's "criticism" as it is often perceived. For those who do not well prepare for teaching, it is also another way of filling the time gap between their lecture and end of the class period. For others, who may be responsible for many class periods per day, note giving provides sort of break from their lecture.

If varieties of writing exercises are provided, students could be helped to develop their thinking. Writing activity is also a means of exercising their

freedom of expressing ideas and thoughts freely in their own words thereby contributing to the development of language skills and acquisition of the content simultaneously.

Carys Jones (2000), suggests the possibility of development of thinking when students personally engage in writing using their personal genre but, the author questions the potential of this type of expressive writing to develop a scientific mind. Sheeram and Barnes (1991) also found that students' written report of an experiment did not reflect any real understanding of what had happened when students were required to write after discussing their results. These authors, however, did not realize the source of failure to understand. Students' understanding in this type of activity originates in the design of the experiment, it's under taking, and interpretation of the results, rather than the written report. The written report is simply the image of what had happened and what conclusions reached. Many other researchers accept the complexity of writing activity, but assert that writing can fulfill both cognitive and meta-cognitive roles (Bereiter and Scardamalia, 1987; Rowell, 1997). Rowell (1997) further suggests that writing is a social practice and views that such an activity helps students appropriate knowledge by writing science in a way that they understand.

According to this author, students develop critical thinking skills such as scientific reasoning, assessing evidence and judging argumentation when

they are given opportunities to write. Furthermore, students become aware of the need to negotiate meaning in conveying their own understanding.

The commonly practiced student writing (recording) in the schools subjected to this study, does not help students to develop the above mentioned abilities for it mainly focused on copying what has been thought out by the adult teacher or the text book writer rather than giving them opportunities to think and write in their own words. This type of writing deprives the students' mind of the power of thinking critically, and makes them accept what ever spoken or written science as ultimate truth because they have no opportunity to write and comment. Different kinds of writing activities focusing both on specific details and a general summary, should be made part of science learning if students have to be encouraged to think about a given concept or idea in a specific or holistic manner. Children can be helped to develop their writing skills if teachers can creatively think of the best ways of promoting their learning in science. For example, by allowing students to work in pairs or groups, they can be required to discuss and report the results of their discussion in writing at whole class level. The use of 'writing frames', that is, skeleton outlines of a given concept that begin with appropriate phrases (Wray and Lewis, 1997 quoted in Monk and Osborne, 2000:100) can also be helpful to promote writing in science. Activities such as cloze procedure, sequencing, labeling and summarizing information can also be given to students so that they perform some kind of writing in learning science at both primary and secondary levels. (Parkinson, 1994).

Experiment as a science teaching/learning activity does not seem to have received emphasis by most of the teachers in the sample schools. Most of the observed experiments were conducted by the teachers and student involvement in this learning activity was observed during the second observation. Student participation in experiment takes 20% while teacher demonstration covers 80% of the experimental work. When taken together with discussion and recording, experiment accounts for less than 4% of the total classroom activities. In all the 18 lessons, each having 40 minutes duration only less than 30 minutes were spent on experiment while recording and discussion consumed 303 and 376 minutes respectively. It is, therefore clear that this activity is the most neglected by the teachers. The importance of experiments as either teacher demonstration or student practical work is dictated by the nature of the curriculum materials used, such as laboratory manuals (Tamir, 1991), but the nature of the topic within a material that is being taught also determines whether or not to use this activity in the classroom transactions. The topics covered in the 18 classes during the two observation sessions were:

‘The respiratory system’ - in two classes

‘The (endocrine) hormonal system’ - in two classes

‘The Human Nervous system’ - in eight classes and

‘Forces and Simple Machines’ - in six classes

With the exception of the lesson topic entitled the “hormonal system,” the other three topics have their own experiment activities suggested in the

curricular materials. Teachers' creativity could have doubled the number of experiments suggested in these materials, had they been enthusiasts for the subject. Six out of the nine schools used experiment at different times (phases) of observation. Table 5 shows these schools. However, in two of these six schools, the activity was consistently followed by the teachers. The rest four schools

Table.8 Experiment (All schools)

Activities	Observation phase	Categories and percentages			Total %
		1	11	111	
Demonstration	1	39(35.5)	–	–	39(35.5)
	11	49(44.5)	–	–	49(44.5%)
Experiment	1	–	4(3.6)	–	4(3.6)
	11	–	18(16.4)	–	18(16.4)
Total		88(80.0)	22(20.0)	–	110(100.00)

emphasized the activity either during the first observation or the second. The topics on which the experiments were conducted are all similar for all the schools. For example, the respiratory system was common topic in schools G and H. While school H conducted teacher demonstration on this topic, no such activity was noted in school G during the instructional practice. Among the rest, schools A, B,C, D and F undertook experiments on 'the human nervous system'; and 'forces and simple machines', which were also common to the rest of the schools.

The importance of practical activities suggested in the syllabus were not often reflected in the classroom instructional practices, and at times, experimental activities planned by some teachers were found neglected while implementing those plans. Contrary to this, however, some teachers were observed conducting experiments in the form of teacher demonstration although this does not appear in their lesson plans. The reason for such discrepancy could be the fact that teacher’s plans are prepared a week ahead of the lesson presentation and teachers may not refer to their plans for detailed activities immediately before they enter their classes.

Table.9 Summary of total classroom activities for all schools

Activities	1	11	111	Total
<i>Discussion I</i>	570 (20.1%)	197 (69.0%)	79 (208%)	846 (29.8%)
	483 (17.0%)	163 (5.8%)	12 (0.4%)	658 (2.02%)
II				
Subtotal	1053 (37.1%)	360 (12.7%)	91 (3.2%)	1504 (53.0%)
Recording I	164 (5.8%)	357 (12.6%)	–	521 (18.4%)
II	254 (8.9%)	446 (15.7%)	–	700 (24.7%)
Subtotal	418 (14.7%)	803 (28.3%)	–	1221 (43.0%)
Experiment I	39 1.4%)	4 (0.1%)	–	43 (1.5%)
II	49 (1.7%)	18 (0.6%)	–	67 (2.3%)
Subtotal	88 (3.1%)	22 (0.8%)	–	110 (3.9%)
Total	1559 (55.0)	1185 (41.8%)	91 (3.2%)	2835(1000%)

Some teachers find the suggested student experiment (practical work) as time consuming because the textbook is content overloaded, putting teachers under pressure of

administrative demands for covering the prescribed topics within the academic year. Therefore, student experiment, which is the form of acquiring science process skills, seems to be subservient to content. Others complain that the materials necessary to carry out these experiments are not available in their schools. In most schools, the science kit is totally absent. In some, the materials, which form the kit, are either broken or lost. For example, claw hammer, scissors, pliers, spring balance, slotted masses, etc, are lost from the kits. Where these materials and others are available, the reason teachers forward is that the number of students in one class is more than what the room can accommodate. Thus, the class size and lack of space become the bottle neck to practical work.

Experiments that do not require the use of special materials are also found overlooked by most of the science teachers. Their defense for such cases was that most of them do not have 'specialty' in science, and they handle the class to respond to administrative obligations of the school. They think of themselves as 'not trained' for teaching at this level because they are TTI graduates, while the current practice intends diploma graduates to teach at the second cycle primary level (grades 5-8). On the other hand, teachers who had diploma in one field of science show negligence over topics that do not relate to their specialty. Teachers with biology background, for example, tended to give less emphasis to practical works intended under the unit entitled "Forces and simple Machines". Therefore, it can be concluded that neither the topic differences, nor scarcity of resources (time, material, space) affect teachers' decisions to use experiment as science teaching/learning activity, but teacher's concerns and values play the major role. In this

regard, Tamir (1991) asserts that teaching by making use of practical work requires a number of skills (eg instructional, managerial) and attitudes (patience, readiness to encounter failure, open-mindedness) on the part of the teacher.

The study found out that discussion is the most frequently employed classroom activity in teaching science than recording and/or experiment. (see Table 9). The specific activity that boosted the share of discussion is teachers' lecture followed by students' responsive talk (answering questions). Student initiated talk was very minimal and when observed, it was only of questioning and oral presentation. (Refer to Table 6).

Students tended to dominate in recording activities mainly by engaging in receptive writing (copying notes and taking dictation), but the overall picture of the classroom instructional practice was more teacher dominated.

Table 10 Comparison of planned and observed activities by percentage

Category of Activities	% Planned		% Observed		%Difference	
	Teacher	Student	Teacher	Student	Teacher	Student
Discussion	36.9	31.2	37.1	19.9	0.2	-15.3

Recording	7.7	10.8	14.7	28.3	7.0	17.5
Experiment	8.2	5.1	3.1	0.8	-5.1	-4.3

Table 10 presents comparison between the planned and observed teacher and student activities across the three general categories. Consistency between the lesson plans and classroom instructional practices, is observed only in teachers discussion activities. Student discussion decreased by a difference of 15.3 percentage points. While there exists an increase or rise in recording activities, both for teachers and students by 7.0 and 17.5 percentage points respectively, experimental activity tended to decrease similarly for the two. The decrease in student activities in the area of discussion and experiment is attributed to the relative rise in recording activities. The occurrence of such ups and downs reflects teachers failure to go by their plans.

It was also noted that some planned experiments were not observed during the instructional practice while in some other classes the experiment was conducted although it did not appear in the lesson plans. The root cause for such mismatch might be that teachers do not refer to the lesson plans, especially to the activities section immediately before they come to the class.

Further inspection of the data to look for the existence of relationship between the planned and observed activities required the use of chi-square test both for teacher and student activities. The test result shows that the

calculated chi-square value at .05 level and 2 degrees of freedom is 9.54 which is greater than the critical value (5.92). The result for student activities also yielded a calculated value of 40.08 which by far exceeds the critical value. Therefore, there is significant difference between the lessons plans and the instructional practice. This indicates that there is significant difference between the intended plan and the instructional practice.

A comparison of the activities observed in the instructional practice against those suggested in the syllabus also showed that there is a discrepancy between the two in terms of the kinds (varieties) of activities (cf. Table 2 and Appendix E), and their magnitude as measured by the students participation index(see Appendix F).

4.4 Interview with the teachers

To get knowledge of factors that inhibit or influence the teaching of science in the primary schools, through the use of student involvement in various activities, five of the observed teachers were made to supply information through interview. Unstructured interview was used to elicit response from these informants. Questions on a given idea or theme, are posed and then the teachers' responses were followed by probe when it deemed necessary. Opinions which are common to all the interviewees are presented in combined manner but those in which differences were observed are presented by quoting their words directly. The first question focused on the teachers background and experience in teaching science at the specified

grade level (could you please tell me your back ground and experience in teaching grade five science?).

Their response showed that many of them are graduates of the TTI program except one who had diploma in teaching biology. Each of these teachers taught the subject for about 4 to 10 years with a total teaching experience of 16- 20 years. In addition to their responsibility to the subject at the grade level under discussion, the interview also showed that these teachers are responsible for other subjects and grade levels. Some of them, especially those in urban schools teach at least two science subjects at two grade levels (eg- grade 5 and 6 science). Urban school teachers again report that they teach in the evening classes while some of them work as private tutors in their free time. Others who are working in rural schools teach three to five subjects at four or five grade levels. This type of multi-grade/subject responsibility reduces teachers' preparation time for science to about 25 or 20% as they have to share their spare time among the 4 or 5 subjects.

Whether teachers assume additional responsibility other than teaching was also another question raised in the interview. Accordingly, some had responsibilities in the school, others in the community, and still others in both the school and the community. Those who assume additional responsibilities in the schools serve as club coordinators, department heads, Unit leaders, or Vice directors. Responsibilities of teachers in the community usually required working as committee members in local kebele

administration, communal self-help organizations, development associations or religious organizations.

It is true that in-school responsibilities are part of teachers' assigned work, and their services in the community is their obligation as citizens. However, its influence in consuming teachers' lesson preparation time can not be over simplified if the subject has to be taught effectively.

Teachers understandings of the participation of their students in the science lessons was also a question raised to the interviewees. According to the teachers, students take part in the teaching learning transaction mostly by asking and answering questions. Questions are often raised and answered by the few who usually volunteer, students, while the rest prefer to keep quite in the classrooms. Most of the time, students raise questions only when the teachers encourage them to do so. Students questions often comprised of questions that require definite answers and only rarely were those requiring extended discussion asked by the students.

“It depends on the emphasis given by the teacher. If the teacher asks questions that need further elaboration of ideas, and encourage students in answering, the students also try to raise their own queions following the foot steps of the teacher. If he/she keeps quite students do same.” (Agro School teacher).

Therefore, teachers make difference in training students develop questioning skills. The kind of questions teachers ask are usually directed to checking students understanding of the lesson topics and therefore consist of lower

cognitive levels. If any one student provided the correct answer, teachers are often satisfied with it, and jump to another point by concluding that the lesson is mastered by all students. These kinds of teacher's questions fail to elicit scientific explanations from students and thus, do not help in developing reasoning and critical thinking abilities. When such questions become common culture of the classroom, students refrain from suggesting their own answers rather than guessing the one the teacher expects.

This, however, does not mean that the teacher should ask too difficult questions that discourage students to make attempts at answering. The questions must be challenging but directed to the level and experience of the students.

Low level questions are asked by teachers mostly to save time because the high level questions require thinking out by the students (Black and Harrison, 2000), and therefore, thoughtful involvement suffers.

Why teachers limit student questions to the end of the lesson time was one of the questions raised to the science teachers. The response given by one interviewee was that:

“Students must have some theoretical background information on the topic in order to exchange ideas with the teacher as well as their peers. I believe that if the lesson presentation by the teacher comes first, students would get good knowledge base to ask and answer questions by themselves.” (Gembe School teacher)

The truth, however, seems that teachers want to save more time for their lecture, probably to meet the expectation of their students. It is common sense that a teacher who holds long lecture is believed to have done his/her works well. This student expectation and teachers' adaptation to this method right from their own training, forces them to stick to prolonged lecture, than to involve students in various learning activities, such as formulating and asking student initiated questions.

How often do you let your students discuss in small groups on questions raised by you, or their peers?

Except one of the interviewed teachers, who claims as some times using group discussion in teaching science, all the rest assert that the method is impractical to use in the classrooms because the kinds of seats, the size of the rooms and the large number of students in a given class pose obstacles against such activity. One of the teachers says that:

“Review questions that appear at the end of each unit in the student text are given to students to work on, in groups out side of the class after each unit is covered in the class. The students must learn and understand the essence of the lesson unit first before they can discuss on it. Even if I try to involve them discuss in groups the available time does not permit to cover the content. The only means is to assign students work in groups in their spare time”. (Kujo School Teacher).

If providing questions to students as a means of igniting “discussion engine” in the form of small groups, is found by teachers as consuming class

time, several ways can be followed to promote involvement of large number of students within limited time span. For example, the teacher can pose a question and ask all students to write their own answers on a piece of paper and pass it to the teacher who may read to the class, or he/she can ask a selected few to read their answers. Another mechanism could be for the teacher to ask questions consisting of multiple choice format requiring students to vote on the answers and then ask some to give their justifications. This type of activity entertains both questions requiring limited answers and those that encourage extended responses from several students.

Do you regularly follow and conduct the experiments suggested in the textbook? Or do you just design your own alternative experiments for achieving the aims of the lesson unit?

The responses given to this question by all the interviewees was similar in that they all complain of the lack of materials for conducting the experiments.

“Only few experiments that can be done by collecting material from the environment (such as for example, practical works with flowers, and experiments with levers) are conducted easily. The rest require either chemicals, or different materials that are not found in the schools. Schools in towns and rural areas should not be expected to do same things. Most of the time I use drawings to show the ideas that need experiments to be carried out by the students, because of lack of materials. (Asendabo school teacher)

“The materials in the science kit are not complete. Some materials like spring balance, slotted masses, claw hammers,

pliers, pulleys, lenses, mirror, etc are missing. These are the most important materials to work with on units like 'forces and simple machines,' and 'light'. But some times, I assign students to bring some materials from home to conduct some experiments. Most of the time, however, I use discussion and question and answer to illustrate the idea behind the experiments." (Geruke School teacher)

Lack of emphasis for practical work in science seems to reside with people working at various levels of the educational structure. On one hand, those who wrote the syllabus gave more emphasis to content with minimum inclusion of experiments. The educational management on the other hand did not pay attention to ensuring the availability of materials and supplies required to implement the suggested practical activities in the schools. Thirdly, the teachers are not equally concerned about the role practical work plays in teaching learning the subject. It should be noted, however, that learning science has both content and process dimensions. Practical work provides opportunities for students to experience science in more concrete ways. It also lays foundations for student discussion as they may be required to work either in pairs or groups. In addition, they can engage in writing science at least in the form of report on practical work. Many educators argue that a science education devoid of practical work fails to reflect the true nature of science. Those who advocate practical work in science advance a number of reasons highlighting its importance: that it motivates students and helps to keep them interested; that it teaches skills to students; that it promotes logical thinking and understanding of theory (Qualter, et al, 1990, Parkinson 1994; Waston 2000). In her discussion of the role of practical work, Driver (1983) asserts that students are more to

comprehend scientific concept in action than an abstract concept presented to them only through written or spoken word.

One important point which the discussion with the science teachers revealed is the reason they emphasize giving notes on the chalk board rather than assigning the students to take it from the textbook. Many reasons were forwarded by each of the teachers. Some say that text books are scarce. The argument of others is economic, while the rest prefer it for their personal convenience. In one school for example, the teacher says that:

“There is acute shortage of textbooks. One textbook is shared among ten students. You can imagine the length of time it would require for students to take their own notes by exchanging one book among many. To overcome this problem, teachers should give condensed notes on the main points”.
(Agaro School Teacher).

Teachers’ conceptions about the ability of their students are also fundamental reasons for some to emphasize note giving although text books are available in abundance.

“The content is so vast that if students are asked to take notes for themselves, they tend to copy everything into their notebooks. This is another way of duplicating the text. If this happens most parents are economically unable to supply additional note books. Another disadvantage is that the students can not summarize the main points from what appears under a given topic.” (Asendabo School Teacher).

“ It is easier for students to read and understand the main points than reading from the text. Some students may get fed

up with long sentences and paragraphs”. (Garuke School Teacher)

“Students may not strictly pay attention and take notes for themselves if they are required to do so. This in turn creates difference among the notes taken by different students. Consequently their results on tests may be affected. As a teacher, I feel more comfortable when I give notes myself because I am also accountable for their” (Gembe School Teacher).

Despite the justifications teachers give to defend their position in giving notes, none of them had ever tried to assign his/her students to take notes from the textbook in their free time. It seems that teachers prefer the activity to maintain a living witness in the eyes of both the school administration and parents. On the other hand, as students tend to consume a relatively longer time in copying the notes from the chalk board, it can be argued that this activity serves as a sole means of relieving teachers from their tire-some lecture by keeping the students busy in the class.

Assigning students to take notes themselves from their textbooks would help them thoroughly revise the content at home before coming to the class for discussion. If this work becomes the daily routine, students would get deep background knowledge on their lesson topics and most students could be involved in class discussion by asking, answering and giving suggestions, or comments supported by arguments. The type of questions they raise and/or

the answers they formulate can show some improvement over what usually characterizes the traditional classroom, because students can think out ideas by taking extended time period when trying to take notes. By getting involved in taking their own notes, students also develop the skill of summarizing ideas in their own words. Coupled with other writing activities such as doing home take assignments, taking notes helps shape the reasoning power and critical thinking abilities. Further more, such a practice would save more time for other class activities. The teachers' strict adherence to students' receptive writing by copying notes from the chalk board, has nothing to contribute to their mental development other than dampening their spirit of thinking and reasoning. Students brought up this way would tend to display the spirit of dependence on the teacher as the source of every information, and causes them to become less self confident in evaluating evidence in any written script.

Concerning the match or mismatch between the planned and implemented activities, a question enquiring whether teachers notice differences, and knew their reasons was raised to the interviewees. From among the responses provided, the following are worth mentioning.

“The attainment of the activities intended in the lesson plans is always governed by what goes on in the classrooms. If students understand the lesson very well, it would be easy to proceed according to the plans. If, however, they fail to do so, it would be a must for the teacher to revise what has already been covered. This in turn, would retard the teacher not to

precede according to his/her plan. “Students” willing participation in the lesson affects whether a planned activity is attained or not. For example, the questions students ask, or the answers they provide, all depend on the level of their understanding. Their failure to answer teacher’s questions or inability to formulate their own is influenced by their understanding of a concept, which may hinder classroom discussion. Thus, a planned discussion may or may, not be achieved as intended. Sometimes the classroom activities may fall less, or may rise above the plan.” (Gembe School Teacher)

For some teachers, the most important part of the lesson plan is the list of topics and/or subtopics to be covered during the lesson, than the details of activities to be followed.

“The lesson plan is mainly a guide for the teacher as to which topic has to be taught. The activities depend on the way the teacher handles the topic in the class. We usually refer to the topics included in the lesson plan than each individual teacher and student activities. Once the topic is known the teacher can determine the best way it can be learnt by the student. It is therefore, possible to go beyond what has been planned.” (Asendabo school teacher).

Before the interview was concluded, the teachers were asked to list the problems they face in teaching science in their respective schools. Accordingly, the following were identified as major problems working against the smooth operation of teaching science in the primary schools.

- Lack of training workshops for teachers on how to effectively utilize the current curricular materials
- Lack of practical skills in using the science kit where available
- Shortage of student text, syllabus and teacher's guide
- Lack of reference books for teachers.
- Prevalence of difficult terminologies in the text book and lack of appropriateness of the content to the age level of the students.
- Lack of materials including the science kit, chemicals and other supplies to conduct some experiments
- Heavy work load on teachers (in addition to their responsibility to teach different subjects, some teachers report that they work in double shifts)
- That content is too vast and too information over loaded that the allotted time does not permit to cover it
- Inflexibility of the student seats for group work, coupled with large number of students, and small room space.
- Lack of laboratory facility and additional time for conducting experiments.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The purpose of the study was to assess whether the suggested methods in the syllabus, and the activities in the teachers plans as well instructional practices promote student involvement in various learning tasks classifiable under three major categories as discussion, recording and experiment.

To meet this general purpose, the study set out to find answers to the four basic questions raised in chapter one. In an attempt at finding out the answers to these questions, relevant data were secured from various sources such as the basic science syllabus for grade five, lesson plans prepared by science teachers and the actual grade five science classrooms. In addition, some of the grade five basic science teachers were also involved to provide information through interview.

The basic science syllabus currently being used in primary schools of Oromia, and sample daily lesson plans prepared by nine primary science teachers were analyzed for the kinds, and magnitude of activities suggested or planned. Science classrooms were observed while implementing the analyzed lesson plans, and the types of activities used in the instructional practices were systematically coded using an observation checklist. The kinds of activities suggested in the syllabus, and those selected in the daily

lesson plans, as well as those observed in the instructional practice were classified in to three major categories, namely; discussion, recording and experiment.

The frequencies of the various activities were counted and entered in to the appropriate rows and columns of tables and their respective percentages were calculated to estimate the degree of emphasis given to student activities along the various categories of activities. Student participation index was also calculated for the suggested methods in the syllabus, as well as the activities observed during the instructional practice. Finally, comparisons were made between the planned activities and those observed in the classrooms to see if there is any difference between the two. Thus, the following are the major findings of the study, presented in the light of the basic research questions.

- 1-1 The highest student involvement was suggested in the recording area, while experiment provides least student participation.
- 1-2 While the intent was the development of “critical thinking abilities and expression of ideas clearly and freely”, these, however, seem neglected because the discussion activities meant to attain them through student involvement are minimal.
- 1-3 The suggested methods are more teacher-centered with little opportunities for students, especially in discussion and experiment.
- 2-1 About 65% of the cognitive objectives were at the lower two levels of knowledge and comprehension, and were intended to be achieved

through discussion and recording activities only. Similarly, about one in two affective objectives were devoted to discussion while more than half psychomotor objectives emphasize recording activity.

2-2 There is no significant difference between the objectives set by the science teachers and the activities selected to achieve them.

2-3 For every activity in the lesson plans, there exists a corresponding student activity showing that almost fifty-fifty relationship would be maintained between the two parties, predicting a kind of teacher-student-centered practice in the classroom.

2-4 'Asking and answering questions', 'taking notes' and 'watching demonstrations' are the three student activities of top priority in the daily lesson plans of the science teachers.

3-1 About 53% of classroom instructional transaction is devoted to discussion, over two-third of which is covered by teachers' talk activities in the form of lecture, questioning and explanation. Students' discussion activities are mainly characterized by some kinds of responsive talk in reaction to teacher structured questions and other oral activities. Student-student interaction such as 'oral presentation', 'questions and answers', account for only 6.1% of the total classroom discussion. Thus, student-centered oral interaction is very low in the primary science classrooms.

3-2 Recording, as a classroom teaching learning activity consumes 43% share of the whole classroom instructional process. Of the total recording work observed, about 66% was covered by students' receptive

writing such as taking notes either in the form of dictation or copying from the chalkboard. The observed teacher-structured student writing was very little, and there was no student directed writing in any of the classrooms.

3-3 Experiment activity, which is a way of acquiring science process skills, came to be subservient to content, because teachers either neglected this work as one variety of science teaching-learning activity, or tended to dominate through demonstrations in classrooms that conducted experiments. Students' share in the experimental activities account for only one-fifth of the instructional process along this area, while the rest was occupied by teachers' demonstrations.

3-4 Student participation index across all categories of activities was found to be low as indicated by the mean overall index of 1.50. Therefore, the classroom instructional practice was more teacher- directed with low student involvement.

3-5 The comparison made between the teachers' plans and the actual classroom practice showed that there was a match between the two only in terms of teachers' discussion activities, while there were wider gaps between the plans and the actual practice along both teachers' and student activities in terms of recording and experiment. The discrepancy between the two was also verified by the chi-square test which showed

the existence of significant difference between the lesson plans, and the actual teaching/learning process both in terms of teacher and student activities.

Post observation discussion with some of the science teachers in the sampled schools helped to disclose their views as to what contributed to the low level of student involvement in the actual teaching learning processes. Accordingly:

4-1 The implementation of the planned activities in the instructional practice is determined by the willing participation of students on one hand, and the way the teacher handles a topic in the classrooms.

4-2 The suggested experiments fell short of implementation mainly due to lack of the necessary resources.

4-3 Teachers emphasize student recording activity in the form of note taking from the chalk board due to various reasons, some of which were:

- to overcome the scarcity of textbooks
- to make for students' lack of skills in summarizing from the text
- to maintain 'standardized' notes for all students
- to promote ease of understanding
- to help students use their notebooks economically

- to put the teacher at ease by giving something tangible to the students

4-4 Among the general problems of teaching science in the primary schools

- lack of material resources of various kinds (curricular materials, the science kit, chemicals and other supplies),
- lack of training opportunities for teachers on how to effectively utilize the curricular materials (syllabus, student text and teacher's guide) and the science kit,
- vastnesses of content, difficult terminologies, inappropriateness of the content to the age level of the students, are the most pressing ones.

5.2 Conclusions

So far attempt was made to identify the kinds of activities used in teaching/ learning primary science, and the level of student involvement across all categories of activities. The analysis of activities in the grade five basic science syllabus showed that there is a gap between the general aims and the activities (methods) suggested for their attainment through student participation in learning tasks. In general, the suggested activities fell short

of realizing the stated aims of the syllabus. Moreover, these activities are more teacher-centered and provided little opportunities for student involvement.

The analysis of teachers' plans for the observed lessons indicated that there was no difference between the stated instructional objectives and the student activities selected to attain them. However, significant difference was noted between the lesson plan activities and those actually observed in the classrooms. The difference was attributed to the relative rise in student involvement in recording activities, which consumed the class time that could have been used for other student activities. The teachers' plans also tended to put high priority on such student activities as 'asking and answering questions', 'taking notes' and 'watching demonstrations', all of which require the students to remain in their seats for most of the class time.

The observation of the instructional practice also disclosed the existence of limited student involvement in discussion and experiment, except that they were given chance to spend a considerable length of time in recording activities.

Therefore, neither the activities suggested in the syllabus, nor those observed in the instructional practice promote maximum student

involvement in learning science in the primary schools. All the activities tended to be more teacher-centered and provided for minimum student involvement. Most of the discussion activities aimed toward teachers' talk and the questions teachers raised usually called for low levels of cognitive operations requiring limited correct answers, which in turn suppressed student participation in class discussion. The recording work, although provided for maximum student involvement, was only of a receptive writing (such as note taking), and there was no student-directed writing activity in any of the classrooms. Students' involvements in experimental activities were also very low.

A number of hypotheses could be advanced for the prevalence of teacher dominance in the suggested activities of the syllabus, or that of the actual classroom practice. First, the failure of the suggested activities to attain the general aims of the syllabus through student involvement might be that the syllabus was designed hastily, and was not well tried-out to see its effectiveness right from the out set. Second, the training background of the teachers might have contributed to the low student participation as the only few had the kinds of qualification in science areas, and most teachers complain of lacking the required qualification to teach at the second-cycle primary level. Third, the student activities teachers selected as the most important for teaching/learning science might promote orderly classroom discipline that would give teachers the right to structure the classroom

practice as they please. Forth, these teachers might perceive the selected activities as the best ways of promoting student involvement as they themselves might have been educated in a similar fashion.

In general, there is some gap between intent and practice that yhe kinds (varieties),and magnitude of activities noted in the lesson plans as well as the instructional practices differed from those suggested in the syllabus.

5.3 Recommendations

Based on the summary of findings and the conclusions drawn, the following recommendations are forwarded.

- 1.It is a matter of common sense to assert that the purpose of any curricular material is to attain the general aims of the subject matter it was designed for. Ensuring this task remains the duty of all those involved in its design and implementation at various levels including the classroom. Periodic evaluation and revision of the curricular materials have the advantage of improving quality and standard with an ultimate purpose of meeting the

general aims/objectives for which they were designed. Therefore, the current basic science syllabus for grade five needs to be improved in such a way that the content and learning experiences focus on the attainment of the general aims of the subject at the specified grade level.

2- The findings of the study have implications for both pre-service and in-service teacher training programs. Thus:

- 4.1 Teacher training colleges need to re-organize their training mechanisms so as to train the would be teachers by involving them in various learning tasks, bearing in mind that the trainees would follow the model of their pre-service training when they end up with the classroom teaching.
- 4.2 The Regional Education Bureau and the teacher training colleges need to devise ways of providing refresher courses on the application of learner-centered methodologies in teaching science.
- 4.3 It would also help a lot if the Regional Education Bureau can identify model science teachers and maintain video recordings of their lessons so that it can be distributed for use in the schools.
- 4.4 Short term training programs on how to use the curricular materials and other science teaching resources, through maximum student involvement in learning the subject needs to be provided for all primary science teachers as the available resources would allow to do so.

3. Providing teachers with training in learner-centered methodologies may not be sufficient for changing their classroom behaviors unless their beliefs about the value of student participation in learning activities are also modified.

