AN INVESTIGATION OF OPTIMUM UTILIZATION OF THE SCIENTIFIC METHOD IN PHYSICS INSTRUCTION AT SECONDARY SCHOOLS IN AMIGNA WOREDA, ARSI ZONE OF OROMIA

BY

BELACHEW TSEGAYE

A THESIS SUBMITTEDTO

THE DEPARTMENT OF APPLIED PHYSICS

SCHOOL OF APPLIED NATURAL SCIENCE

PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE MASTERS OF SCIENCE DEGREE IN PHYSICS

OFFICE OF GRADUATE STUDIES

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

AUGUST, 2017

ADAMA, ETHIOPIA

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Advisor approval sheet

As research Advisor, I certify that I have read and evaluated this Thesis entitled " An investigation of optimum utilization of the scientific method in physics instruction at secondary schools in Amigna woreda, Arsi zone of Oromia regional state" by Belachew Tsegaye under my guidance and supervision. I hereby recommend that it could be submitted for defense as it fulfills to requirements for degree of Master of Science in physics.

Advisor	Signature	Date
Dr. Alemu Kebede	______________	____________

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY GRADUATE STUDIES PROGRAM

Examination Committee Approval Sheet

This is to certify that the thesis prepared by **Belachew Tsegaye** :- An investigation of optimum utilization of the scientific method in physics instruction at secondary schools in Amigna Woreda, Arsi zone of Oromia regional state and submitted for partial fulfillment of the requirement for the degree of Master of Science in physics complies with the regulations of university meets the accepted standard with respect to originality and quality.

Signed by the Examining committee Signature

____ ____________________

Chairman, Department of Graduate Signature

____ ____________________

Advisor signature

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Examiner (internal) Signature

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Examiner (External) signature

____ ____________________

DECLARATION

I, the under signed graduate student, declare that this is my work, and that all sources or materials used for the thesis have been duly acknowledged.

Name: Belachew Tsegaye

Signature---------------------------------

Place: School of Applied natural science

Adama Science and Technology University

Date of Submission: August, 2017

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LIST OF ACRONYMS

AAAS –American Association for the Advancement of Science

AAPT-American Association of Physics Teachers

SMT -Scientific method of teaching

SML -Scientific method of learning

AGSS -Amigna Gesgar Secondary school

AGPS - Amigna Gesgar Preparatory school

SSS - Sedie secondary school

ABSTRACT

The main purpose of this study was to investigate the optimum utilization of the scientific method in physics instruction at secondary school in Amigna woreda, Arsi Zone of Oromia regional state. To attain this objective, descriptive survey research method was employed. The subjects of the study were 128 (72 male and 56 female students) and 8 physics teachers. Stratified sampling followed by simple random sampling (lottery method) technique was employed to select the sample students, purposive sampling technique was used to select the schools and availability sampling method was employed for physics subject teachers. To gather the necessary data, questionnaire, observation and document (textbook) analysis was used. The gathered information was analyzed using both quantitative and qualitative methods. The findings of the study indicate that 62.5% of the secondary school teachers rarely and never use SMT as classroom instruction. But 62.5% of them were interested in the method and 71% of the students were interested in SMT. The weighted mean value of teachers and students for students textbook checklist 1.62(54.3%) and 1.69(56.3%) respectively indicated that the students textbook content were appropriate for the application of SMT as classroom instruction. Findings from the study suggest that classroom interaction seemed to be mostly teacher-centered and tended not to support inquiry-based teaching and learning which is noted for promoting conceptual change and enhance performance.

CHAPTER ONE

INTRODUCTION

Education is a light that shows the mankind the right direction to surge. If education fails to inculcate self-discipline and commitment to achieve in the minds of student, it is not their fault. We have to convert education into a sport and learning process has to generate interest in the students and motivate them to stay back in the institution than to run away from it. Education should become a fun and thrill to them rather than burden and boredom. It is an integral part of their growth and helps them become good citizens (Damodharan, 1999)

Education is an engine for the growth and progress of any society. It not only imparts knowledge, skills and inculcates values, but is also responsible for building human capital which breeds, drives and sets technological innovation and economic growth. In today's era, information and knowledge stand out as very important and critical input for growth and survival. Physics as one dynamic discipline of science is always developing and flourishing rapidly. The concepts and principles of Physics are applied in various daily activities such as in the technology of transportation, communication, power generation, and space discovery and exploration. Physics has contributed so much towards the development and concordance of our lives especially in this era of Science and Technology (.Rengarajan, 1999)

Physics is an important subject for economic, scientific and technological development (Zhaoyao, 2002). Empirical studies from the field of Physics Education Research (PER) have out lined essential suggestions about physics curriculum which are generally accepted and believed to widen the knowledge and increase the horizon of understanding of physics by learners. Among the essential suggestions are: (1) the method of teaching physics should be guided discovery instead of the traditional lecture method used in teaching the subject. This was recommended due to the fact that, learning efficiency and effectiveness take place during explanation, experimentation and discussion; (2) there should be interaction between the physics teacher and the students. In this case, it is believed that if genuine and helpful interaction exists between the teacher and students, the students will be able to inform teachers what they find difficult in physics thereby reducing the difficulties they (students) encounter (Adeyemo, 2010, p. 101).

These features are essential because it is believed that if they are dully and critically followed and applied in any given situation and at any given time, teachers will be able to make physics easy to comprehend by learners (Adeyemo, 2010). Teaching methods are the most important techniques employed by teachers to realize the objectives of a lesson (Borich, 2007). Thus, teachers of all disciplines including physics use various teaching methods for achieving lesson objectives. For physics students to achieve their full potential in schools, it would seem to be essential that teachers engage in effective teaching practices (Borich, 2007). Classroom based investigation has been able to determine effective research-based teaching practices that are related to positive learning outcomes.

The physics syllabus embodies a wide range of activities such as projects, experiment, demonstrations and scientific enquiry skill. All these objectives are achieved by the teacher through giving innovative and appropriate instructions to the physics students. The physics teacher is therefore required to design teaching sequences with appropriate teaching pedagogies that has the potential to develop students' interest in the subject and their abilities to properly respond to situations they may encounter in their world of life that their knowledge in physics may be of benefit.

1.1 Background of the study

The primary purpose of teaching at any level of education is to bring a fundamental change in the learner .(Tebabal & Kahssay, 2011). To facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods that best suit specific objectives and level exit outcomes. In the traditional epoch, many teaching practitioners widely applied teacher-centered methods to impart knowledge to learners' comparative to student-centered methods. Until today, questions about the effectiveness of teaching methods on student learning have consistently raised considerable interest in the thematic field of educational research (Hightower et al., 2011). Moreover, research on teaching and learning constantly endeavor to examine the extent to which different teaching methods enhance growth in student learning. Quite remarkably, regular poor academic performance by the majority students is fundamentally linked to application of ineffective teaching methods by teachers to impact knowledge to learners (Adunola, 2011). Substantial research on the effectiveness of teaching methods indicates that the quality of teaching is often reflected by the achievements of learners.

According to Ayeni (2011), teaching is a process that involves bringing about desirable changes in learners so as to achieve specific outcomes. In order for the method used for teaching to be effective, Adunola (2011) maintains that teachers need to be conversant with numerous teaching strategies that take recognition of the magnitude of complexity of the concepts to be covered.

The role of the teacher however, is the most important. Without a well-educated, strongly motivated, skilled, well-supported teacher, the arch of excellence in education in high school physics collapses. The teacher is the keystone of quality. Education research has continued to show that an effective teacher is the single most important factor of student learning (Darling-Hammond, 2000;Marzano,2007).Marzano characterizes an effective teacher as one who matches the strategies to the students.

Active learning techniques can empower students to make good decisions and take active role in their learning, increase their motivation and improve their knowledge acquisition. Encouraging students to work or co-operate with each other in constructing their own understand is another principle of effective teaching identified. Co-operative learning groups promote community aspects of the classroom and the role of discussion with peers in helping students to learn physics. Peer-peer discussions in co-operative learning groups promote meaningful learning by helping learners to help each other to incorporate new experiences and information into their existing cognitive structures thereby fostering the development of deep understanding. The implication is that students can learn from each other and develop a shared understanding of the topics they are learning. For Ethiopia, therefore, in order to make teaching/learning physics fruit full, it is mandatory to implement appropriate scientific method of teaching in physics and investigate the extent and effective utilization of the method.

1.2 Statement of the problem

The question about the method of teaching and learning physics is one of the most important questions which should worry each teacher. Nowadays teachers and students are offered a great variety of methods. Teachers are advised to organize their lessons (and the whole teaching process) in an interactive way and use active methods of teaching.

According to P. Skurski (2008), using only one method is enough for students to learn physics successfully. It is the method of learning based on the method of scientific physics-the only most effective method of understanding our nature. The main tasks of any physics teacher are to help students realize the purposes and the essence of this method as well as create favorable conditions so that students can use this method consciously and more and more independently.

The secondary school physics curriculum (first cycle, grade 9 and 10; and second cycle, grade 11 and 12) takes a competency based active learning approach underpinned by three broad outcomes: knowledge, values and attitudes and skills The student's textbook and Teacher's Guide places emphasis on learner –centered classroom 'not only to help students to acquire knowledge, but also to develop problem solving and decision making skills, as well as good attitude to society and the world around us.

However, in Amigna Woreda preparatory and first cycle Secondary Schools, the researcher observed that, physics teachers mostly focus on lecture method of teaching rather than using those methods that help them to make students achieve learning outcome. By choosing scientific method of teaching, physics teachers should help the students to think freely, to become an autonomous person with confidence in their own knowledge and skills, capable to continue their education or realize the world of work. Therefore, what the study investigated was the optimum utilization of the scientific method of teaching physics in preparatory and first cycle Secondary Schools.

1.3 Objectives of the study

1.3.1 General objective

The main objective of this research is to investigate the optimum utilization of scientific method in physics instruction at secondary schools in Amigna Woreda Arsi Zone of Oromia.

1.3.2 Specific objectives

The specific objectives of the study are:

To assesses physics teachers' preparation of the scientific method of teaching physics.

To investigates physics teacher's utilization of scientific method of teaching physics.

To examine secondary school students interest in the scientific method of learning physics.

To examine the appropriateness of the student's textbook for the application of SMT.

1.3.3 Research Question

To investigate the optimum utilization of scientific method of teaching physics the researcher asked the following questions:

Do physics teachers prepare to use the scientific method of teaching physics?
Does the textbook topics invite teachers to use the scientific method?
Do secondary school students interested in learning physics through scientific method?

1.4 Significance of the study

The result of this research might be beneficial for physics teachers, students, curriculum developers, educational authorities, and in general educational system. Physics teachers may be able to select different appropriate apparatus, tools and materials to promote their teaching by scientific method. Physics teacher may be engaged students in investigations by ensuring a safe working environment make available science tools, materials, media, and technological resources. Students may be prepared for the lifelong challenges by developing competence.

1.5 Delimitation of the study

The study was delimited to Oromia regional state ,East Arsi Zone ,in Amigna Woreda secondary schools (at two Secondary Schools of Grade 9 & 10 and one preparatory school of grade 11 & 12).The study would investigate the optimum utilization of scientific method in physics instruction. Even though the problem under investigation was common throughout the country, the study has been delimited to small area (at woreda level) due to time and money constraints. Moreover, there are many teaching methods and teaching resources that are not implemented by secondary school teachers which enhance students' academic achievement in physics the study only focus on the scientific method of teaching physics at secondary school

1.6 Limitation of the study

Education in Ethiopia still has many problems and challenges that need concrete solution to enable students achieve academic performance in general and in secondary school physics in particular. However, the study was limited to woreda level due to the reasons given here under:

- The lack of adequate literature concerning our country context. There are no journals about the topic under investigation.

- There is also a problem of internet access to get the current information
- There is shortage of time because the researcher conducted the study on job.ie not free from teaching process
- There is shortage of finance
- The study also limited only to scientific method of teaching because of time and money constraints.

1.7 Organization of the study

The contents of the study was organized in such a way that the first part contains background of the study, statement of the problem, objectives, significance, delimitation, Limitation and organization of report. The second part contains review of related literature .The third part contains research design, research area, population, Sample and sampling technique, Instrument and data collection procedure. The fourth part contains data presentation, analysis and discussion. The last part contains Conclusion and recommendation. Appendices were also located at the end of the report.

CHAPTER TWO

REVIEW OF RELATED LITRATURE

2.1 Introduction

The primary purpose of teaching at any level of education is to bring a fundamental change in the learner (Tebabal & Kahssay, 2011). To facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods that best suit specific objectives and level exit outcomes. In the traditional epoch, many teaching practitioners widely applied teacher-centered methods to impart knowledge to learners comparative to student-centered methods. Until today, questions about the effectiveness of teaching methods on student learning have consistently raised considerable interest in the thematic field of educational research (Hightower et al., 2011). Moreover, research on teaching and learning constantly endeavour to examine the extent to which different teaching methods enhance growth in student learning. Quite remarkably, regular poor academic performance by the majority students is fundamentally linked to application of ineffective teaching methods by teachers to impact knowledge to learners (Adunola, 2011). Substantial research on the effectiveness of teaching methods indicates that the quality of teaching is often reflected by the achievements of learners. According to Ayeni (2011), teaching is a process that involves bringing about desirable changes in learners so as to achieve specific outcomes. In order for the method used for teaching to be effective, Adunola (2011) maintains that teachers need to be conversant with numerous teaching strategies that take recognition of the magnitude of complexity of the concepts to be covered.

2. 2 Meaning of Teaching and Teaching Method

According to Uzoka (2002) the word “method” can be described as a strategy or a way something is done. Uzoka defined teaching method as a strategy the teacher uses to impact knowledge by directing and guiding the learning process, while Cyril (2013) described teaching methods as a process, planned and followed during teaching and learning to enhance delivery of the subject matter. These authors see teaching methods as a system of communication between a teacher and a learner with the intention of bringing about certain cognitive and psychological changes in the learner. They described teaching methods as a recurrent pattern of teacher behavior, applicable to various subject matters, relevant to learning and can bring about changes in learners behavior.

According to Ayeni (2011), teaching is a continuous process that involves bringing about desirable changes in learners through use of appropriate methods. Adunola (2011) indicated that in order to bring desirable changes in students, teaching methods used by educators should be best for the subject matter. Furthermore, Adunola (2011) sustained that teaching methods work effectively mainly if they suit learners' needs since every learner interprets and responds to questions in a unique way. As such, alignment of teaching methods with students' needs and preferred learning influence students' academic attainments.

2.2.1 Teacher-Centered Methods

Under this method, students simply obtain information from the teacher without building their engagement level with the subject being taught (Boud & Feletti, 1999). The approach is least practical, more theoretical and memorizing (Teo & Wong, 2000). It does not apply activity based learning to encourage students to learn real life problems based on applied knowledge. Since the teacher controls the transmission and sharing of knowledge, the lecturer may attempt to maximize the delivery of information while minimizing time and effort. As a result, both interest and understanding of students may get lost. To address such shortfalls,(Zakaria, Chin & Daud ,2010) specified that teaching should not merely focus on dispensing rules, definitions and procedures for students to memorize, but should also actively engage students as primary participants.

2.2.2 Student-Centered Method

With the advent of the concept of discovery learning, many scholars today widely adopt more supple student-centered methods to enhance active learning (Greitzer, 2002). Most teachers today apply the student-centered approach to promote interest, analytical research, critical thinking and enjoyment among students (Hesson & Shad, 2007). The teaching method is regarded more effective since it does not centralize the flow of knowledge from the lecturer to the student (Lindquist, 1995).The approach also motivates goal-orientated behavior among students, hence the method is very effective in improving student achievement.

2.2.3 Teacher-Student Interactive Method

This teaching method applies the strategies used by both teacher-centered and student-centered approaches. The subject information produced by the learners is remembered better than the same information presented to the learners by the lecturer (Jacoby, 1978).The method encourages the students to search for relevant knowledge rather than the lecturer monopolizing the transmission of information to the learners. As such, research evidence on teaching approaches maintains that this teaching method is effective in improving students' academic performance (Damodharan & Rengarajan, 1999).

2.3 Teaching Methods in Science Education

There are different teaching methods employed in science education in Ethiopian secondary school. Miles (2015) asserted that it is expected of a teacher to implement a range of instructional strategies that will bring academic success to all the science students. For any method to be able to bring good result in the present age, it should be method that promote maximum social interaction. Social interaction between students and between teacher and student plays a crucial role in learning (Nguyn and Williams, 2012).

Lecture method is often used to deliver a large amount of information to the students in a short period (Berry, 2008). According to Berry (2008), lectures are designed to deliver new information to a large group of students. This method is known to be effective in dealing with a large class. However, it could also be used for a small class. Research indicates that this method dominates most of the tertiary institutions.

Research shows that students' retention in a lecture-based science courses is weak. According to Bok (2006), an average student only retains 42% of what he or she learned after the end of the lecture and 20% one week later. Research shows that teaching method like the lecture method commonly used does not help the students to acquire sufficient functional understanding (Bok, 2006). Berry (2008) argued that lecture method lacks the effectiveness of an active learning approach. In the opinion of Mazur E. &et.al (2008), lecture method causes the bad reading habit among the students. Students taught in lecture-based classes learn less than those taught with activity-based reformed methods. Lecture method is frequently a one – way process unaccompanied by discussion, questioning or immediate practices that makes it a poor teaching method. Lecture method concentrates on information rather than learner. In the lecture method the teacher tell the students what to do instead of activating them to discover for themselves (Miles, 2015). Demonstration teaching method is a useful method of teaching because it improves students' understanding and retention (McKee, Williamson, and Ruebush, 2007).

According to Miles (2015), the demonstration is effective in teaching skills of using tools and laboratory experiment in science. However, the time available to perform this demonstration is very limited in a classroom setting. Therefore, a demonstration often designed to allow students to make observations rather than through hands-on laboratory (McKee, Williamson, and Ruebush, 2007).

2.4 The scientific method of teaching physics

According to Atilla Cimer (2007) the development of science is a process in which further research is carried out in the situations when, as the current knowledge proves, there is a necessity and possibility of enlarging and modifying that knowledge. There may also exist a possibility of creating and improving methods and scientific tools. The analysis of the current situation in the aspect of general attempt to create knowledge (being functional both practically and cognitively) is the first and very important feature of science. We are trying to achieve knowledge both very detailed and more general according to the idea of great unification. It results from a conviction based on the current experience in the realization of the process of cognition that a coherent model of physical reality (which allows deducing about all its specific aspects) is possible.

A characteristic feature of physics is also the analyses of the currently recognized models and theories in an attempt to create methods and theoretical systems which make it possible to see a more general and synthetic image of physical reality. In that process models and theories which have already been recognized are becoming special cases or bordering cases of new models and theories. Another important feature of physics as a science is its rational-empirical character. In the process of the development of physics there exist two, significantly different although linked with each other strategies. These strategies depend on the current level of knowledge and methods connected with certain area of cognitive (scientific) exploration.

The first strategy was worked out at the beginning of the development of science and it was used in the exploration of less known areas with a relatively small empirical base of data built in the current research. It was not good enough to formulate some model or theories, or to explain certain facts observed from the point of view of models and theories which have already been formulated. This strategy uses, at the rational level, a kind of non-deductive thinking. The results of the empirical exploration of any interesting area of our reality (obtained through observation, experiments and measurements) are collected in the form of an empirical base of data concerning certain area. They are being analyzed in order to establish the relation between them and in order to point out some possible regularity.

The working hypothesis about these regularities (that is the statements justified in the light of empirical data recognized as the true ones after fulfilling all the criteria applied in empirical research) become the basis of the planning and realization of further research. Generalized hypotheses with a defined range of application, justified in the light of empirical data, become empirical rules. At certain level of exploration and development of science these statements are regarded as true (in the Aristotle sense with the later modifications of the definition of truth) and they are part of scientific achievements. This strategy, because of the qualities described above, is sometimes called a rational-empirical, inductive-generalizing procedure (Atilla Cimer 2007)

The second strategy, which transfers science into another stage of its development, is the strategy which uses deductive thinking. Because of a high level of empirical knowledge and a number of existing notions (concepts) and tools of descriptions it is possible to create such a relational abstract system with an imposed relation of interpretations, which would enable a description of the real system features or it would enable us to predict its behavior in assumed conditions. And the second strategy is realized in such a situation. This strategy in the process of constructing models and theories requires an empirical verification which involves formulating (through deduction) hypotheses about the features of the modeled system (justified in the light of accepted assumptions) and it also involves doing empirical research which leads to the affirmation of these hypotheses (and as a consequence it leads to the affirmation of the model or theory from which they have been derived) or to their falsification (in the situation when the empirical results contradict the theses of those hypotheses) and to the rejection of the model or theory. Besides the realization of the above presented strategies and methodological rules of building physical knowledge structures in the development of science, the applications of knowledge of reality and methods of studying those applications seem to be essential. The processes of using knowledge and methods of physics in other branches of science, technology and human activities give us data which are included in general physical knowledge and become inspiration or a starting point for further basic research and applications. In the reflective practice of teaching in view of the observed low efficiency in reaching the planned complex educational goals, look for methods and techniques which could to raise the efficiency of learning and teaching.

2.4.1 Scientific method is the optimal method of learning physics.

Nowadays, when a great variety of methods is being widely used, in order to learn physics successfully, it is better to use scientific method. Successful learning means realizing" the curriculum of basic (general) education". The comparison of the model of the scientific method (rational-empirical science) and the model of different processes of developing and forming of a human being's competence as well as taking into consideration all known features of an effective individual and social activity of a human being allow us to formulate the following hypothesis (Skurski 2008).

Let's assume that the aim of teaching physics is to create conditions for a thorough development of learners in accordance with their natural possibilities and predispositions as well as to shape their general and subject competence (necessary for effective learning and realizing private and professional tasks), then in the face of characteristic features of a human being's competence and the features of the scientific method (worked out in the process of scientific advancement) as well as the essence and main goals of education, an optimal method of learning physics is the one which is a direct transposition of the scientific method of teaching physics into the area of education.

Therefore, the basic task of a teacher is to make students aware of the goals and essence of the scientific method. Physics teachers should also do their best to create good conditions for their students to use that method consciously and independently. Educational methods which are common in the teaching practice may become good ways of supporting the teaching and learning processes. The hypothesis about the value of a learning method formulated in this way should be considered to be the basic postulate for teachers teaching physics- the postulate to make a teaching process and scientific research Similar.

2.4.2 From the scientific method to the practice of learning physics.

Skurski (2008) indicate that, the reason for formulating the hypothesis about one method of learning physics was a conviction based on the analyses of the processes of cognition of a human being as well as the studies of educational (teaching) practice. Only creating conditions for an initiation of natural processes of cognition (learning) and forming these processes according to one perfect model, which is the scientific method of physics, is the only optimal way of learning physics. This method helps students reach a complete development and form their physical and general competence.

According to Skurski (2008), the scientific method of physics comprises five stages of procedure (" a 5- stage model of learning physics"). It takes into consideration some stages of research procedures characteristic of physics and it presents situations and actions important for reaching educational goals. Stage (1) is the stage of observation, feeling and the stage of making attempts to act in the situations in which, in order to satisfy different needs, cognition, creating and transforming a separate area of the natural world or the world made by a human being seem to be necessary. Stage (2) is the stage of a deepened analysis of the situation from stage 1, a detailed definition of goals and a planned cognitive or application procedure. It is all done after taking into account the procedures or designing in scientific research. Stage (3) is the stage of the realization of all the planned practical and cognitive tasks along with the defined standards and the rules of the scientific learning physics of method.

Depending on the level of students' educational development as well as their abilities to understand physics, there are realized rational-empirical strategies based on non-deductive reasoning or based on deductive reasoning. Stage (4) is the stage of synthesis and sorting out the effects of cognition (learning). These effects are simply students' ideas and knowledge about a given area of physical reality, methods of its exploration, creating and transforming. Stage (5) is the stage of using acquired knowledge, using methods in the situations from stage (1) and in new situations. Situations which need using knowledge and methods should convince students of the value of the realized tasks as well as of the value of acquired knowledge and skills. They should also raise the level of their self-assessment.

The situations requiring an application of knowledge and methods are the situations in which one has to diagnose, for example, and explain all the observed states, phenomena, processes or features of the chosen areas or elements of reality. They are also situations in which one has to predict changes or to design and apply a new method or solutions. Some situations need the creation of new areas of reality or they need the modification of the areas which already exist. Each didactic unit has to include a functional structure having all the 5 stages of students' procedures which are realized consciously.

As a result of the consequent and conscious realization of the procedures in accordance with these model learners that in their minds build a coherent system of ideas and knowledge which become tools (models and theories) in their further activity. Creating and sorting out one's own experience gained at each stage of educational and practical activity and analyzing their effects is in accordance with natural and effective learning which is part of a man' s private and professional activity. Therefore, it is a good preparation for such an activity. It is a condition of an individual and social development.

2.5 How to Teach the Scientific Method

2.5.1 The Old Scientific Method

The old scientific method is taught by most teachers in the United States and elsewhere today (AAAS,1993) . However, it is thought to have some problems**.** Most scientists don't follow the order of the most-often-taught Scientific Method. They skip steps, start in the middle and work out to either end, repeat steps, etc. They also use imagination and intuition in the discovery of scientific truth or invention.

Scientists differ greatly in what phenomena they study and how they go about their work. Although there is no fixed set of steps that all scientists follow, scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence... (AAAS,1993). Secondary school science teachers would strive to stretch their understanding about "The Scientific Method" and work to teach this enlightened approach to their students. William Harwood, (AAAS,1993) discovered that the traditional linear approach is actually much more circuitous.

2.5.2 The new model

The main component to the new model: Asking Questions, is where it always starts, but the many secondary steps can start anywhere around the wheel and be repeated many times in an attempt to answer the question: such as observing, defining the problem (or question), re-forming a question, investigating the known (which is our standard research), articulating the expectation, carrying out the study, examining the results, reflecting on the findings, and communicating with others.

First of all, “One thing teachers to get across to their students is that they are not doing science only when they are making a measurement. Rather, they are doing science when they are looking things up, when they are talking about data or ideas for designs, and so forth." These aren't activities to "get ready" to do science, they are the activities of science! When you are doing a simple review of statistics (mean, mode, median) you are doing science! When you are teaching the elements of experimental design, you are doing an important part of Science. Prof. Harwood puts it this way: “...it is perfectly reasonable to focus a lesson on a single activity. For example, how to look up information (investigating the known) or how to determine if data are valid Teachers need not always do a full inquiry investigation with their students to be teaching them important ideas, skills, and necessary habits of mind that are required to do science.” This makes me feel good about breaking such a complicated topic down into manageable portions that can be taught in any order, whatever seems right for the day.

Purpose state the problem
Research find out about the topic
Hypothesis predict the outcome to the problem
Experiment develop a procedure to test the hypothesis
Analysis record the results of the experiment
Conclusion compare the hypothesis to the experiment's conclusion.

A common list of the steps of the scientific method

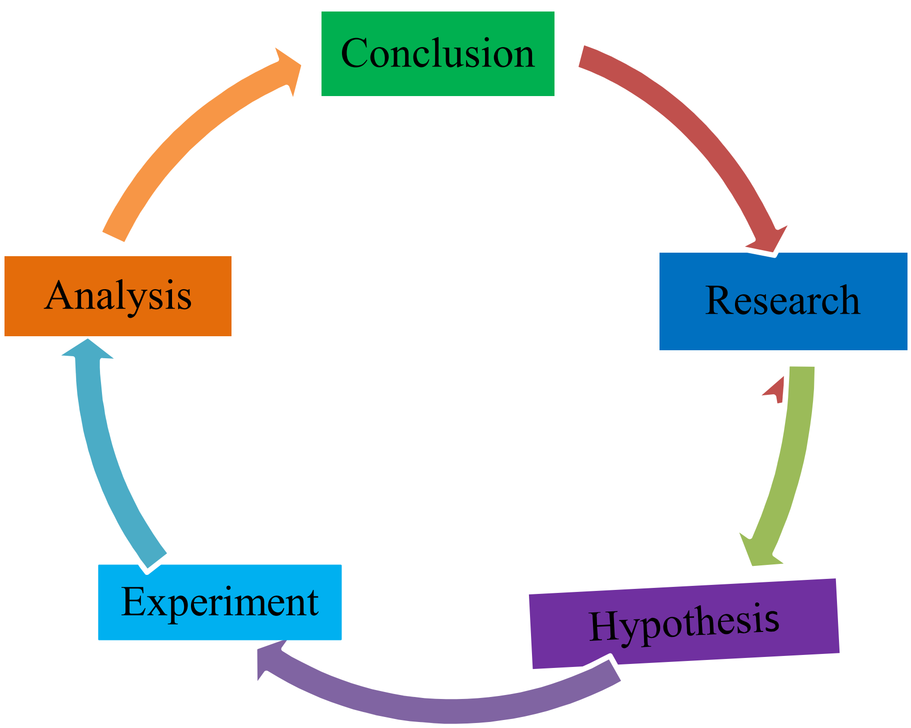

Figure 1.The cyclic steps for scientific methods

2.6 Teachers' knowledge, beliefs, and thinking

The cognitive revolution heightened awareness that teachers actively think as they teach and that what they know and believe about teaching very much affects the classroom decisions they make. During the last two decades of the twentieth century, there were substantial analyses of what teachers know and believe (Calderhead,1996).what follows in this section is an amalgamation of conclusions from these previous reviews of the evidence.

Teachers think before they teach (i.e., they plan for the year, this unit, this week, what will be covered today, and what will be covered in this lesson; Clark & Yinger, 1979), and they think as teaching proceeds (e.g., they react to student needs). Teachers also can think after they teach, reflecting on what went on in their classroom, the effects of their teaching, and how their teaching might be improved in the future. All of this thinking is informed and affected by various types of knowledge possessed by teachers: Teachers know how to teach, having learned classroom management strategies, instructional strategies, motivational techniques, and a variety of theories of learning. They have beliefs about themselves as teachers. They have subject matter knowledge, including knowledge about how particular subjects can be taught (i.e., pedagogical content knowledge; Shulman, 1986). With respect to every type of knowledge that teachers can possess, there are individual differences between teachers in what they know and believe. For example, some teachers know more than do others about cognitive strategies instruction.

Among those knowledgeable about cognitive strategies, some believe that strategies should be taught directly, whereas others think that students should be helped to discover powerful strategies but not be told explicitly how to carry them out. Some teachers even know about strategies instruction but choose not to teach strategies because they do not believe that reading comprehension really is a consciously strategic process (e.g.,Shulman, 1986). Teacher beliefs can powerfully affect teaching, including beliefs about self as teacher (e.g., I'm not good at teaching math.), the nature of students (e.g., They don't want to learn. The students do not have much prior knowledge that can be related to science lessons.), effective classroom management (e.g., Students should be seen and not heard).

A good teacher is clearly in charge of the classroom. In a good classroom, students are self-regulating.), and the nature of effective teaching and learning (e.g., Teachers should be coaches more than dictators. Students learn best through direct instruction. Students learn best when given opportunities to construct their own knowledge).

A teacher's knowledge is acquired over a long period of time, with some of it reflecting information garnered from experiencing kindergarten through college education as a student. Some was conveyed formally in courses in college—for example, education methods courses. Other knowledge was acquired on the job as a function of gaining experience in the classroom, observing other teachers, and experiencing professional development provided to teachers in the field.

Teachers' practical knowledge of schools dramatically shifts with experience. Only through actually teaching in a working school can subtle knowledge of the teaching craft be acquired. Formal knowledge of teaching, however, can transform as teachers attempt to use modern conceptions of teaching and learning compared to conceptions of teaching and learning that predominated when they were taught. Thus, knowledge of writing can change as a function of experience as a writing workshop teacher of composition.

The shift can be from a focus on writing as mastery of mechanics (which was the emphasis during schooling for many who are now teachers) to writing as a process of planning, drafting, and revising (which is the current focus of most curricular thinking about composition), with concerns about mechanics most prominent as the composition product is being polished. Knowledge of and beliefs about mathematics instruction can change when a school district decides to move away from curricula emphasizing procedural learning to curricula emphasizing student construction of mathematical understandings and real-world problem solving. To become an expert professional takes a while (5–10 years; Shulman(1986) both to learn how to teach and to believe one can teach well—despite the fact that while they are in teacher education programs, many are very confident (probably overconfident) that they will be good teachers.

2.7. The role, education, qualifications, and professional development of secondary school physics teacher

Excellence in high school physics depends on many things: the teacher preparation, course content, availability of apparatus for laboratory experiments, a clear philosophy and workable plan for meeting students' needs, serious dedication to learning goals, and adequate financial support. The role of the teacher, however, is the most important. Without a well-educated, strongly motivated, skilled, well-supported teacher, the arch of excellence in high school physics collapses. The teacher is the keystone of quality (AAPT 2009)

Education research has continued to show that an effective teacher is the single most important factor of student learning (Marzano, 2007). Marzano characterizes an effective teacher as one who matches the strategies to the students. The effective teaching of physics includes using strategies to promote constructivist learning, conceptual understanding of physics topics, and to develop skills and methods for students to understand the process of scientific inquiry. These teaching strategies include the use of cooperative learning, technology tools, activities performed in order to collect, analyze, and report data. The teacher needs to understand the use of formative and summative assessments and techniques to create a learning environment where students share the responsibility for their own learning. As our understanding of how to more effectively engender student learning grows this altered understanding is leading to changes in teacher preparation but it also indicates the need for ongoing professional development.

2.7.1 Teaching Quality and quality teacher

As indicate by (AAPT, 2009), there is no firm consensus within the field as to exactly what constitutes high-quality teaching or a quality teacher. A quality teacher is one who has a positive effect on student learning and development through a combination of content mastery, command of a broad set of pedagogic skills, and communications/interpersonal skills. Quality teachers are life-long learners in their subject areas, teach with commitment, and are reflective upon their teaching practice. They transfer knowledge of their subject matter and the learning process through good communication, diagnostic skills, understanding of different learning styles and cultural influences, knowledge about child development, and the ability to marshal a broad array of techniques to meet student needs. They set high expectations and support students in achieving them. They establish an environment conducive to learning, and leverage available resources outside as well as inside the classroom(Marzano,2007).

These definitions suggest that teaching quality in practice constitutes a set of actions and activities that improve student outcomes. As is often the case, despite some areas of common ground, the field remains engaged in active debate and discussion around some key aspects of defining quality teaching and its impacts. Understandings of "quality" can be contentious. For example, in a widely cited review of research on teaching quality, Laura Goe, an expert on teacher effectiveness with the Educational Testing Service, cautions against "a one-size-fits-all definition … because a variety of occasions and purposes exist for which different definitions may be appropriate (Goe, 2007, p. 3)." She notes that "indicators of quality relevant to making initial hiring decisions may be different from the indicators used in granting tenure, rewarding excellent performance, or identifying and supporting struggling teachers (Goe, 2007, p. 2)." She speaks to the point that different definitions may be relevant in different contexts and at different points of a teacher's career.

A good physics teacher is someone who realizes that among the most valued and significant roles of a science teacher are to help a student understand a body of information and the processes of scientific investigation. This teacher derives great pleasure when students truly comprehend a concept or principle and appreciates the role scientific inquiry had in its development.

2.7.2 Teacher Self-Preparation

Quality teaching depends on what is done by the teacher before stepping into the classroom. According to AAPT (2009) Preparation is key:

- ❖ Set the goals in terms of conceptual and process outcomes.
- ❖ Decide what students will do in the classroom to achieve these goals.
- ❖ Decide how to assess whether the goals are achieved, including the roles of both formative and summative assessments.
- ❖ Maintain a positive outlook and be flexible.
- ❖ Prepare subject material: sequencing and correlating to standards.
- ❖ Prepare lab apparatus and equipment.

2.7.3 Teacher-Student Interaction

As AAPT (2009) the primary role of a teacher is to establish a learning environment where all students are:

- able to learn and is motivated to learn, an environment that is both challenging and supportive:
- Establish a learning community consisting of the teacher and the Students.
- Recognize and celebrate diversity in students.
- Design or select varied instructional strategies to accommodate different learning styles.
- Establish and implement a consistent classroom management plan.
- Listen to student ideas and be prepared to address them.
- Guide students to view the place of physics in the wider scientific world.
- Encourage and support students in discovering concepts independently when possible.
- Maintain appropriate methods of communication with parents to keep them informed of student progress and attitude and address any issues that may arise.
- Make sure that student activities are challenging yet doable, and that students can track their progress.
- Make sure that students can establish connections between classroom activities and everyday experiences.
- Assess student progress both formatively and summative.

2.7.4 Community Building in the Classroom

AAPT (2009) cited that, it is important for students to feel comfortable in the classroom. A good teacher should make connections with the students

- Be authentic and genuine.
- Learn the names of all students early and speak to each student every day.
- Recognize and acknowledge students' interim successes that lead to final understanding of concepts and principles.
- Be available to provide extra help and be willing to respond to questions.
- Involve and include all students in classroom activities.
- Be fair and consistent in the treatment of each student.

- Be accurate and specific in evaluating student progress

2.7.5 Scientific Literacy Development

According to AAPT (2009) Science does not happen only inside the classroom. Science teachers are charged with producing informed consumers of science who will be able to make decisions whenever science intersects public policy. Thus the teacher should be an informed and critical observer of science, concerned with developing scientific literacy:

- Take advantage of community resources
- Connect with scientists outside of the classroom through speakers and field trips
- Provide students with opportunities to learn, for choice, and for success.
- Provide meaningful applications, and manageable tasks for students to perform.
- Bring scientific news into the classroom.
- Discuss implications of new technology.
- Address real-world problems that may be interdisciplinary.
- Provide activities and opportunities for students to experience physics outside the classroom.

2.8. Physics Teachers' Perception of Effective Teaching of Physics in Secondary School

The principal objective of education has been the development of the whole individual. The hope of every seasoned parent is that the school will be able to develop the child's potentialities in life. The only way to achieve this is by giving the child education that is of high quality and standard. Education involves the total efforts of the community to raise its political, social and economic standard of living. The implication of this is that it is an inevitable tool for surmounting ignorance, disease, poverty and to produce functional individuals who have positive attitudes towards the growth and development of the society.

The development of any nation depends largely on the level of its scientific and technological literacy. Physics which is one of the sciences is indispensable to technological advancement. Physics has helped in the development of modern technology through the application of its principles to modern invention. Its study enhances an understanding of the interplay of forces in nature because it forms veritable armor against superstition which muddles technological advancement anywhere. Physics as a course of study is perceived generally to be very interesting, vast, mathematical and experimental. Almost all aspect of life science, both living and nonliving has something to do with physics, ranging from engineering to mathematics, biology, chemistry. Physics is one of the pre-requisite subjects for the study of engineering, technological, medical and other applied science courses in the university. Its study instructs a person in the art of critical thinking, how to pose questions and how to solve problems. It also equips graduates with mathematical and information technology skills. The study of physics has been and will remain of tremendous importance to mankind because it is capable of explaining natural phenomenon and everyday occurrences. Physics is the most basic and fundamental of all the sciences and according to Adeyemi (2003) and Oraifo (2005), it plays a very important role in scientific and technological advancement that affects the lives of mankind.

Effective teaching is the teaching that successfully achieves the learning objectives by the pupils as identified by the teacher (Atilla Cimer, 2007). Atilla Cimer (2007) identified four attributes as important factors in the classroom in relation to effective teaching. The strength of each of these attributes determines how receptive pupils are to learning. These attribute are also identified as a key cause of success in the classroom. They are

1. Personality and will
2. Intelligence
3. Sympathy and tact
4. A sense of humor

Studies in the past that have attempted to relate these attributes to educational outcomes, have completely ignored what actually happens in the classroom but had looked at the input characteristics such as the attributes of the teacher and students and also at the output such as the examination results and then tried to relate the two without considering what happens in the classroom. However more recent research on effective teaching has focused on activities in the classroom such as the students to which these personalities attributes help.

Based on the theoretical principles of constructivism which is a teaching approach that holds the view that knowledge are personally constructed and reconstructed by the learner based on his prior knowledge or experience, Atilla Cimer (2007) identified the main principles of effective teaching in physics as follows:

1. Dealing with students' existing ideas and conceptions
2. Encouraging students to apply new concepts of skills into different contexts
3. Encouraging students participation in lessons
4. Encouraging student inquiry
5. Encouraging co-operative learning among students.

Determining students' existing ideas and conceptions has been recognized as an important variable in physics teaching and a necessary part of teaching strategies developed (Goodrum, Hackling and Rennie, 2002; Tytler, 2002a, 2002b). Hipkins (2002) argued that teaching science and physics is effective when students' existing ideas, values and beliefs, which they bring to a lesson, are elicited, addressed and linked to their classroom experiences at the beginning of a teaching programme. Students do not enter the classroom as empty vessels into which new ideas can be poured by teachers (Tyler, 2002a). Meaningful learning therefore occurs as students consciously and explicitly link their new knowledge to existing knowledge structure. The implication is that effective instructional approaches have to be based on what is already known by the learner.

Determining students' existing ideas and conceptions in physics may also increase students' awareness of them which is necessary for meaningful learning (Goodrum, Hackling and Rennie, 2002). When students become aware of their previously 'tacit' ideas they have a chance to compare them with scientific ones and change if necessary. Through determining students existing conceptions, teachers can develop appropriate instructional strategies that move these unscientific ideas and conceptions towards scientific ones (Hipkins, 2002). Another technique for effective physics teaching is the encouragement of students to participate in lessons. Parkinson (2004) argued that for effective learning to take place, students are required to be active in the learning process. Daboer, (2002) also believes that the more students are involved in the learning process the more they learn the topic. Active learning techniques can empower students to make good decisions and take active role in their learning, increase their motivation and improve their knowledge acquisition. A fourth element of effective teaching of physics identifies is encouraging students inquiry Students engaging in inquiry during physics lesson have a lot of positive effects in their learning of the subject physics. These include students developing a wide range of skills such as psychomotor and academic or intellectual skills. Psychomotor skills we all know involves doing something physics, like gathering and setting up apparatus, doing the experiments, making observations, measuring and recording data and drawing graphs. Encouraging students to work or co-operate with each other in constructing their own understand is another principle of effective teaching identified.

Co-operative learning groups promote community aspects of the classroom and the role of discussion with peers in helping students to learn physics. Peer-peer discussions in co-operative learning groups promote meaningful learning by helping learners to help each other to incorporate new experiences and information into their existing cognitive structures thereby fostering the development of deep understanding (Joyce, Weil and Calhonn 2000a). The implication is that students can learn from each other and develop a shared understanding of the topics they are learning.

CHAPTER THREE

METHODOLOGY /DESIGN OF THE STUDY

3.1 Research Design

The survey design was employed for this study. This design was considered most appropriate since questionnaire, classroom observation and textbook analysis were the main instruments used for data collection from the secondary school teachers and students of the population. Survey is more economical since many classroom instructional methods can be studied at the same time.

3.2 The Study Area

The study was conducted at secondary schools in Amigna woreda which is located in Arsi Zone of Oromia Regional State. As indicated in Figure2**,** it is bordered from the East with Bele Gesgar woreda ,from the West with Robe Woreda, from the North-Sude,Gololcha and Chole woredas and from the South with the Bale Zone

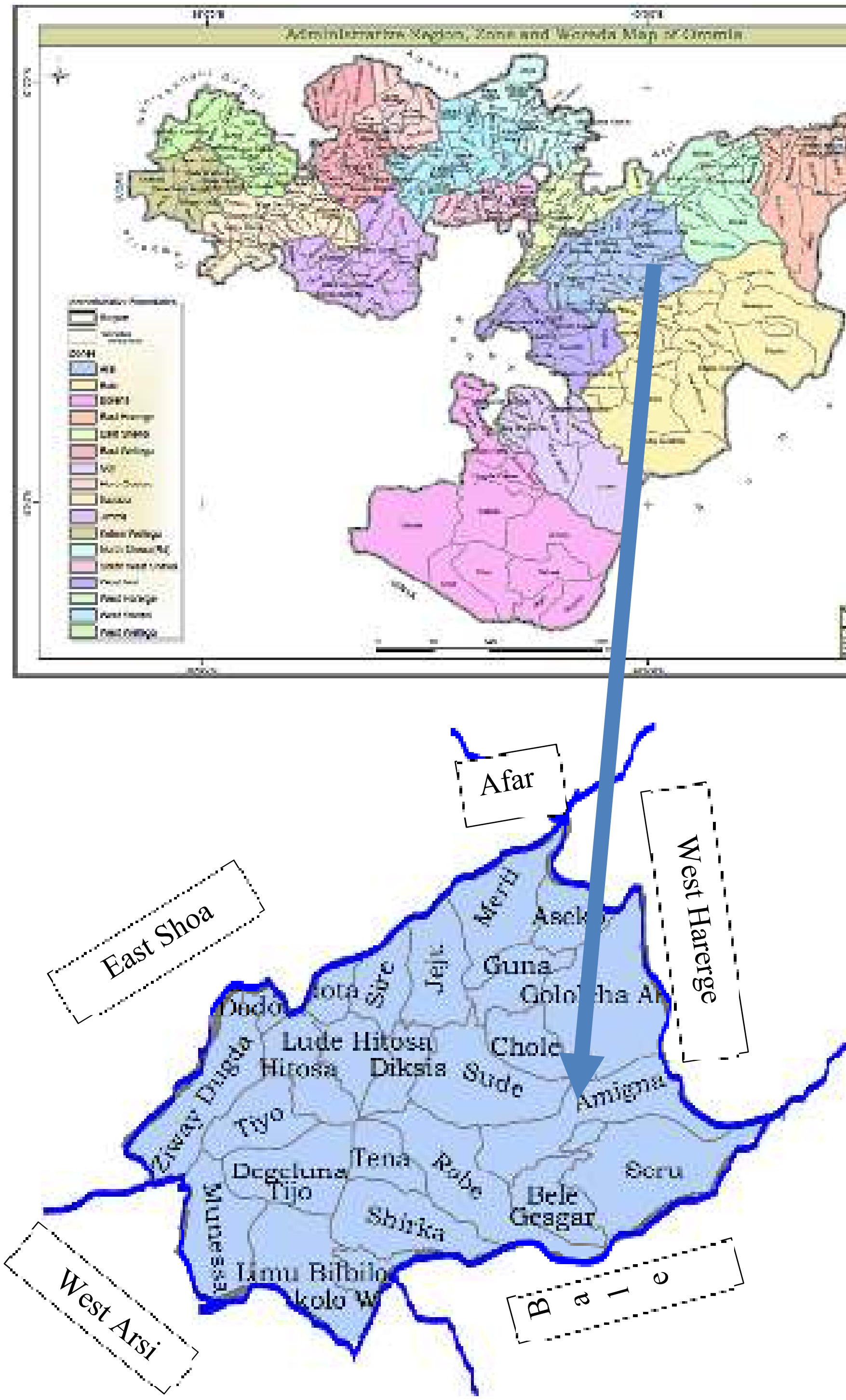

Figure 2. Map of Oromia regional state (at the top) and Arsi Zone including Amigna Woreda (at the bottom)

3.3 Population

Amigna has three government secondary schools and has no private secondary school at the time of the study. These schools were divided into first cycle secondary school (grade 9 & 10) offering physics as a subject for all students and second cycle secondary school (grade 11 & 12) and offering only for natural science as a subject. The population for the study comprised those of secondary school physics teachers and secondary school students offering physics in the public schools. The three secondary schools were chosen because of availability reason. Secondary school students were selected because of purposive case of the study.

Table 1 : 2009 E.C. Number of secondary school Teachers in Amigna Woreda

No	**School**	**Grade Assigned**	**Teachers**		
			Male	Female	Total
1	AGSS	9	2	1	3
		10	2	0	2
2	SSS	9-10	1	0	1
3	AGPS	11	1	0	1
		12	1	0	1
	Total	9-12	7	1	8

Source - Directors office of each school

Table 2 :2009 E.C. Number of secondary school students in Amigna Woreda

No	School	Grade	Students		
			Male	Female	Total
1	AGSS	9	308	252	560
		10	247	202	449
2	SSS	9	38	32	70
		10	36	33	69
3	AGPS	11	39	24	63
		12	61	20	81
	Total	9-12	729	562	1292

Source - Directors office of each school

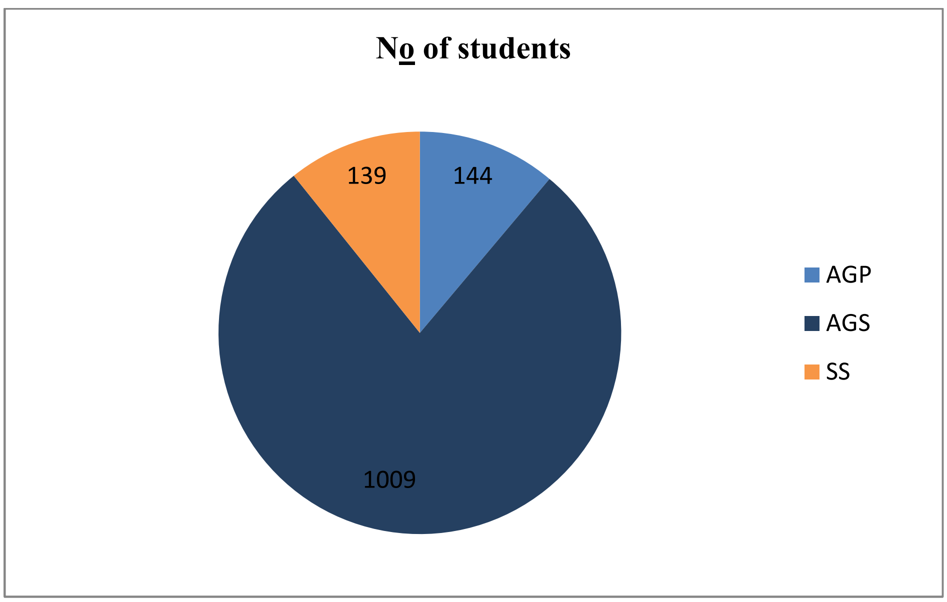

Figure 3:Total population of students from three schools-

AGP-Amigna gesgar preparatory school

AGS –Amigna gesgar secondary school

SS –Sedie secondary school

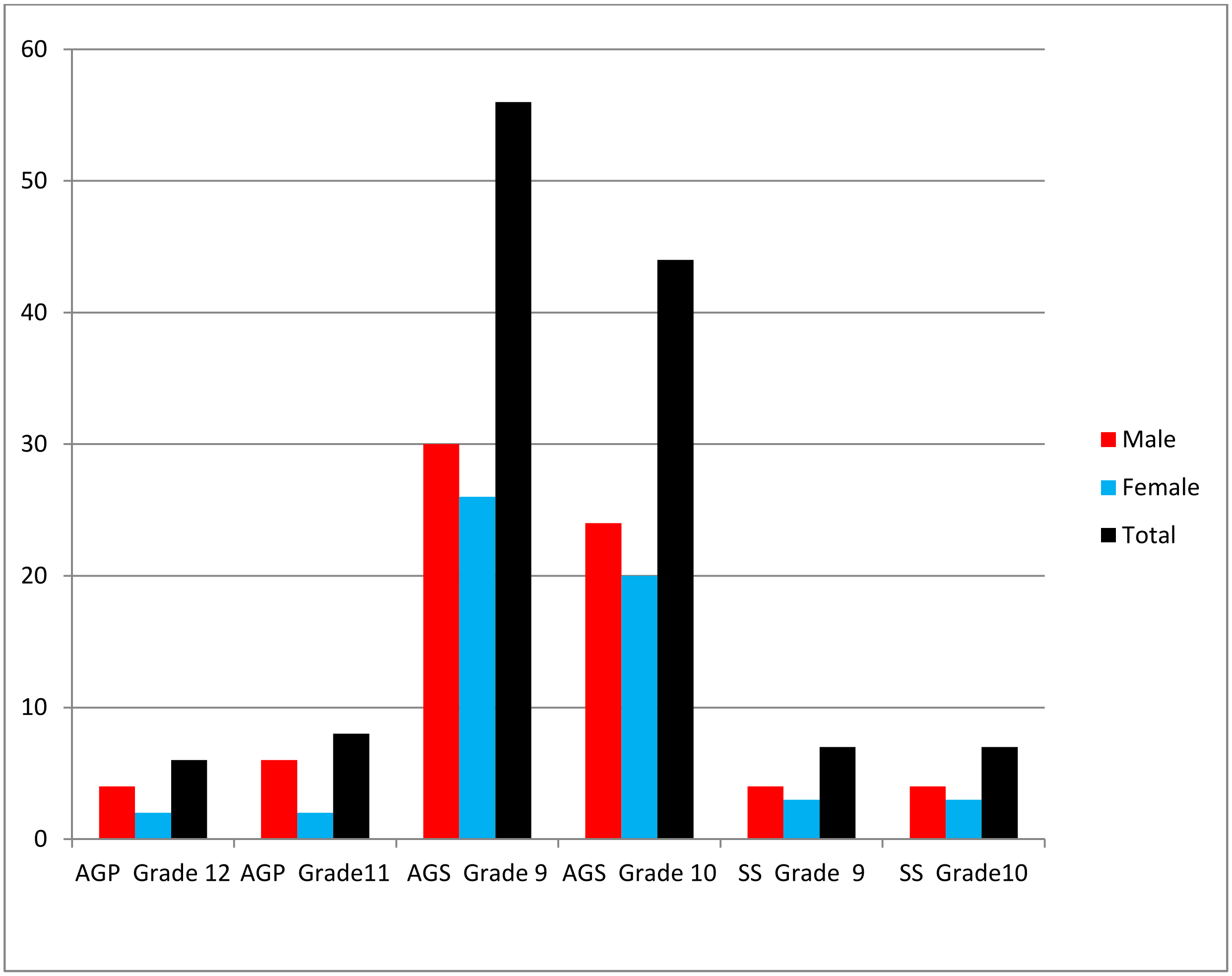

Figure 4.Sampe size of students from three secondary Schools selected randomly from stratified randomly selected sections of preparatory and secondary Schools.-

AGP-Amigna Gesgar Preparatory School (grade 11 &12)

AGS-Amigna Gesgar Secondary School (grade 9&10)

SS-Sedie Secondary School (grade 9&10)

3.4 Sample and Sampling Technique

Preliminary situation, at the time of the study, showed that there are three secondary schools in Amigna woreda. Availability sampling was then used to select the three secondary schools. In each school,10% of the total students are taken as sample. In all cases, the simple random technique was employed to select students. The sample size for the teachers comprised all physics teachers in the schools.

In all, there were 8 physics teachers–5 from Amigna Gesgar secondary school, 2 from Amigna Gesgar preparatory school and 1 from sedie secondary school. Majority of the teachers representing (87.5%) were males with the remaining one (12.5%) being female. The teachers who participated in the study were generally in their youth as 75% of them were less than 40 years. Only 25% of the teachers were above 40 years. As indicated in table 2, The sample size for the students were 128 with 72 (56.3%) males and 56(43.7%) females respectively.

3.5 Instruments

Questionnaire and classroom observation were the main instruments used for data collection for the study. Two forms of both open and closed ended questionnaire (teachers' questionnaire and students' questionnaire) were developed and used for data collection. The response was collected and tabulated and coded for further analysis. The Statistical Package for Services and Solutions (SPSS) was used to determine the percentage, mean and standard deviation values were obtained.

3.6 Data Collection Procedure

.Collection of data for the study started with negotiating access to the schools. Permission was sought from the school directors in each school. In each school visited, the students' questionnaire was administered to the secondary school students. Students were made to complete the questionnaire at a sitting. The completed questionnaires were collected the same at the same time. The teachers' questionnaire was also administered to the physics teachers in all the three Secondary schools selected for the study. As much as we could, physics teachers' questionnaires were collected at the time. This resulted in a return rate of 100%. All responses (from both teachers and students) were scored, analyzed and presented in tables

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

This chapter presents and discusses the data obtained from the teachers, students and researcher's classroom observation. Since the researcher collected information (data) about secondary school classroom instructional method in physics class the type of collected data was primary data. Then the collected data was tabulated, discussed and interpreted .Therefore, in this chapter, the first section discusses the analysis and finding of questionnaires; and the second section reports the data of the observation of the physics class.

4.1 Teacher Qualification

According to(AAPT, 2009) quality teacher is one who has a positive effect on student learning and development through a combination of content mastery, command of a broad set of pedagogic skills, and communications/interpersonal skills. Quality teachers are life-long learners in their subject areas, teach with commitment, and are reflective upon their teaching practice. They transfer knowledge of their subject matter and the learning process through good communication, diagnostic skills, understanding of different learning styles and cultural influences, knowledge about child development, and the ability to marshal a broad array of techniques to meet student needs. They set high expectations and support students in achieving them. They establish an environment conducive to learning, and leverage available resources outside as well as inside the classroom.

Academic qualification of the secondary school physics teacher verses teacher quality was first examined. Research findings confirm teacher quality as one and most influential factor on students' achievement and many a time, academic preparation of teachers, type of certificate, professional learning and years of teaching experience are taken as indicators of teacher quality (Darling-Hammond, 2000). In this study, only academic qualification (types of certificate) and teaching experience of the teachers are discussed.

Table 3 :Amigna woreda Secondary school physics teachers' profile

3.1		21-30		31-40		41-50		51andAbove	
		No	%	No	%	No	%	No	%
	Age(in years)	3	37.5	3	37.5	2	25	0	0
3.2		Male		Female		Total			
		No	%	No	%				
	Sex	7	87.5	1	12.5				
3.3		Major(physics)		Minor(Math's)		Others			
		No	%	No	%	No		%	
	Field of study	8	100	8	100	-		-	
3.4		Diploma		BSc/B.Ed.		MSC		Others	
		No	%	No	%	No	%	No	%
	Qualification	-	-	8	100	-	-	-	-
3.5	Teaching	5 and less		6-10		11-20		21 and more	
	Experience (in	No	%	No	%	No	%	No	%
	years)	1	12.5	2	25	4	50	1	12.5
3.6		10 and less		11-15		16-20		More than 20	
	Teaching load	No	%	No	%	No	%	No	%
	per week	2	25	2	25	4	50	0	
3.7	No of class size	30 and less		31-40		41-50		More than 50	
		No	%	No	%	No	%	No	%
		0	0	8	100	0	0	0	0

The secondary school physics teachers' level of academic attainment and teaching experience are presented below in Table 4 and Table 5 respectively.

Table 4.Level of Academic Qualification of Physics Teachers

	Teacher's Qualification	No	%
4.1	MSc	0	0
4.2	BSc/BEd	8	100
4.3	Diploma	0	0
4.4	Others	0	0

As presented in Table 4, all secondary school teachers in Amigna Woreda have been attended at least four years of tertiary education. All the teachers (100%) have Bachelor of Science or Bachelor of Education degree. There is no teacher with a master's degree and also there was no teacher with diploma. When asked to indicate other professional qualifications acquired if academic certificate was not in education, no one indicates.

Teacher professional competence determines the academic and professional qualifications of the teacher, content knowledge and teaching approach/pedagogy a teacher uses and how effective the teacher will use the approach.

Table 5. Amigna woreda Secondary schools physics teachers teaching experience (in years)

Range of teaching experience (in years)	N	%
1-5	1	12.5
6-10	2	25
11-15	3	37.5
16-20	1	12.5
More than 20	1	12.5

Data in Table 5 indicate that only one-eighth of teachers (12.5%) has teaching experience above 20 years. Majority of the teachers (37.5%) have teaching experience of eleven to fifteen years. It can be inferred from Table 5 that all the teachers have at least four years of tertiary education and the all of physics teachers have their qualifications in education. This means that physics teachers were trained as professional teachers and have been recruited by government to teach, a phenomenon commonly practiced in Ethiopia. That is, university graduates with qualifications in education are recruited to teach in secondary school. The recruited teachers may have the content knowledge and competent in subject matter, and can be said of their pedagogical knowledge and relevant skill-set to promote effective delivery of instruction. As noted by (Darling-Hammond, 2000), to produce larger student achievement gains, one must be competent in both subject matter content and pedagogical skills. The data on teachers' years of teaching experience in table 1 in relation to the age distribution as shown in Table 3 also suggest that most of the secondary school teachers in the study area were experienced physics teachers.

As cited by Shulman (1986) , To become an expert professional takes a while (5–10 years) both to learn how to teach and to believe one can teach well—despite the fact that while they are in teacher education programs, many are very confident (probably overconfident) that they will be good teachers

4.2 Instructional Methods

Even though there are so many instructional methods used in physics classroom, the study discussed only the scientific method of teaching physics relative to those which are commonly known by most of the secondary school teachers .The researcher discussed only eight of the methods because of time and money constraints. Therefore the selected methods were presented and discussed from the viewpoint of the teachers and students

There are different teaching methods employed in science education in Ethiopian secondary school. Miles (2015) asserted that it is expected of a teacher to implement a range of instructional strategies that will bring academic success to all the science students. For any method to be able to bring good result in the present age, it should be a method that promotes maximum social interaction. Social interaction between students and between teacher and student plays a crucial role in learning (Nguyn and Williams, 2012).

Table 6. Some teaching methods to be used as classroom instruction at secondary schools

No.	Instructional method	Respondents	Frequency of response									
			Always		Often		Sometimes		Rarely		Never	
			No	%	No	%	No	%	No	%	No	%
6.1	Lecture	T	4	50	2	25	2	25	0	0	0	0
		S	67	52.3	32	25	20	15.6	4	3.1	5	4
6.2	Demonstration	T	1	12.5	1	12.5	4	50	2	25	0	0
		S	40	31.3	26	20.3	35	27.3	18	14.1	9	7
6.3	Problem solving	T	3	37.5	2	25	3	37.5	0	0	0	0
		S	67	52.3	30	23.4	25	19.7	2	1.6	4	3.1
6.4	Group discussion	T	3	37.5	4	50	1	12.5	0	0	0	0
		S	29	22.6	27	21.1	64	50	5	4	3	2.3
6.5	Experimental	T	0	0	0	0	1	12.5	4	50	3	37.5
		S	7	5.5	17	13.3	19	14.8	35	27.3	50	39.1
6.6	Scientific	T	1	12.5	1	12.5	1	12.5	2	25	3	37.5
		S	10	7.8	7	5.5	22	17	35	27.3	54	42.2
6.7	Observation	T	0	0	0	0	4	50	1	12.5	3	37.5
		S	15	11.7	16	12.5	10	7.8	45	35.2	42	32.8
6.8	Assignment	T	0	0	0	0	7	87.5	1	12.5	0	0
		S	21	16.4	19	14.8	72	56.3	6	4.7	10	7.8

Note :T- represents Teacher , S- represents Student

As shown in Table 6, the dominant teaching methods which teachers always use in most physics classroom was lecture method which accounts 50% in teachers and 52% in students' response respectively. Interactive demonstration, experimental and scientific methods which are inquiry in nature were rarely used by the teachers. In contrast, (25%) and (37.5%) of the teachers response, which accounts a total of (62.5%) were rarely and never respectively employ the scientific method of teaching.

Likewise, 50% and 37.5% of the teachers rarely and never used experimental method as classroom instruction respectively. Additionally, for the open ended question, physics teachers were asked to indicate other teaching methods used as classroom instruction in the physics classroom. Most of their response (62.5%) indicate that they use lecture mixed with problem solving and small group (a group of five students) discussion method of teaching and the rest (37.5%) did not respond the open ended question.

The findings as indicated in Table 6 show that pattern of interaction in most physics classrooms is the teacher initiated and dominated teacher-student interaction. This is not in consonant with international standards which recommend that teachers of science plan inquiry-based programs for their students and should also interact with students to focus and support their inquiries, recognize individual differences and provide opportunities for all students to learn (Bybee, Carlson-Powell, & Trowbridge, 2008). The findings also lead to the recommendation of teaching for effective learning (learning with understanding) where students take responsibility of their own learning through active construction and reconstruction of their own meanings for concepts and phenomena (Borich, 2007).

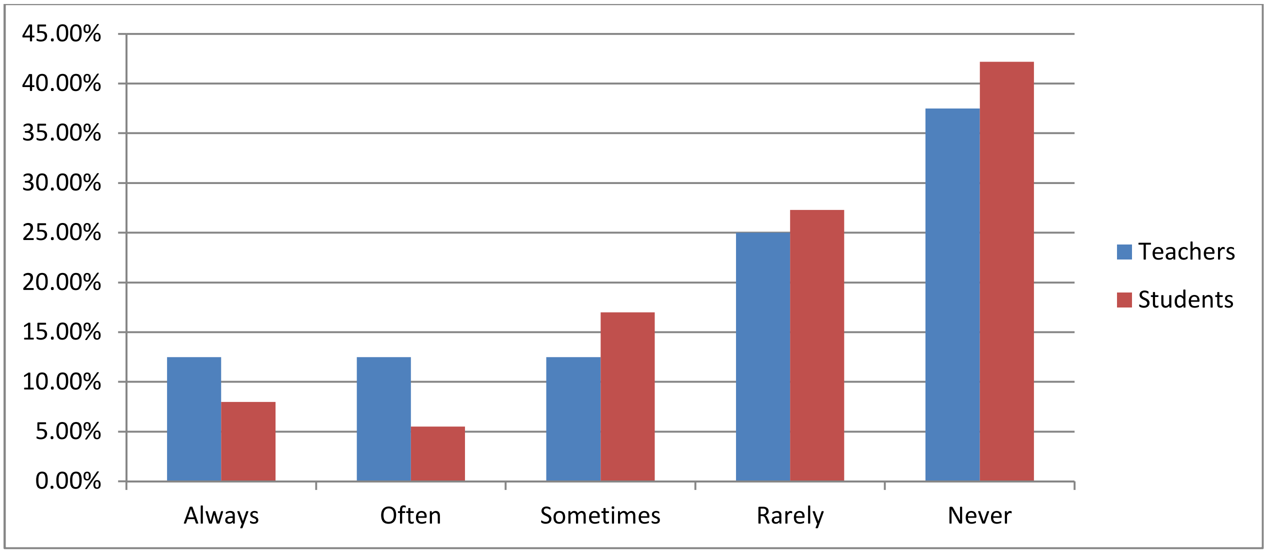

Figure 5 - Secondary school Teachers and students response about how often physics teachers use the scientific method of teaching

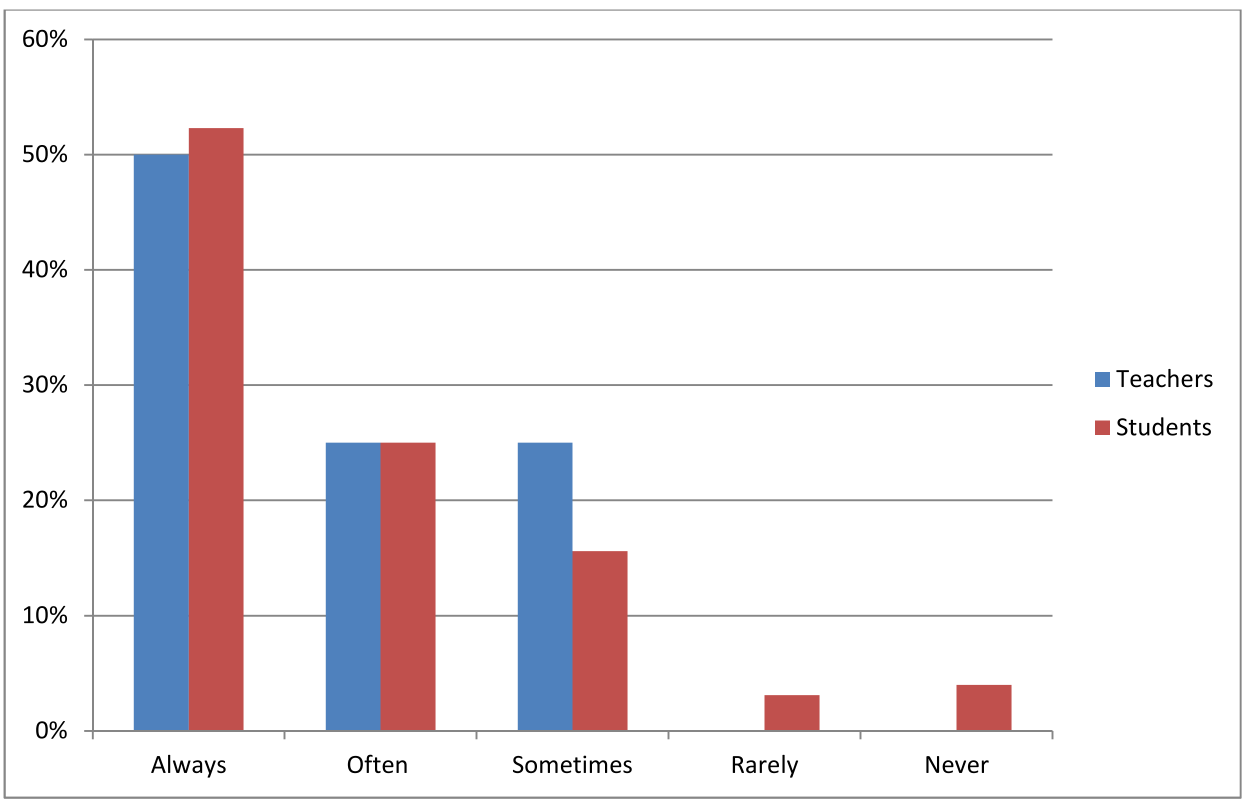

Figure 6 - Secondary school Teachers and students response about how often physics teachers use the lecture method of teaching

Miles (2015) asserted that it is expected of a teacher to implement a range of instructional strategies that will bring academic success to all the science students. For any method to be able to bring good result in the present age, it should be method that promote maximum social interaction. Social interaction between students and between teacher and student plays a crucial role in learning (Nguyn and Williams, 2012)

Lecture method is often used to deliver a large amount of information to the students in a short period (Berry, 2008). According to Berry (2008), lectures are designed to deliver a new information to a large group of students. This method is known to be effective in dealing with a large class. However, it could also be used for a small class. Research indicates that lecture method dominates most of the tertiary institutions.

Research also shows that students' retention in a lecture-based science courses is weak. According to Bok (2006), an average student only retains 42% of what he or she learned after the end of the lecture and 20% one week later. Research shows that teaching method like the lecture method commonly used does not help the students to acquire sufficient functional understanding (Bok, 2006). Berry (2008) argued that lecture method lacks the effectiveness of an active learning approach.

Table 7- Advantages of utilization of SMT at secondary school

No	The scientific method of teaching (SMT)physics:	Respondents	Responses										M
			SA		A		LA		DA		SDA		
			N0	%	N0	%	N0	%	N0	%	N0	%	
7.1	Equips the learner to be the builder of his/her knowledge through active participation and leads him /her to become problem solver.	T	3	37.5	5	62.5	0	0	0	0	0	0	4.38
		S	70	54.6	44	34.4	5	4	5	4	4	3	4.34
7.2	Instruction is student – centered	T	2	25	5	62.5	0	0	1	12.5	0	0	4.00
		S	51	39.8	61	47.6	9	7	5	4	2	1.5	4.20
7.3	Inculcates manipulative skills.	T	1	12.5	6	75	1	12.5	0	0	0	0	4.00
		S	40	31.3	45	35.2	21	16.4	13	10	9	7	3.75
7.4	Retention, recall and transfer of knowledge is facilitated	T	3	37.5	5	62.5	0	0	0	0	0	0	3.75
		S	60	46.8	47	36.7	11	8.6	7	5.5	3	2.4	4.20
7.5	Encourages analytical thought and promotes intuitive development.	T	1	12.5	6	75	1	12.5	0	0	0	0	4.13
		S	42	32.8	57	44.5	14	11	7	5	8	6.3	3.92
7.6	It is slow and time consuming method and so less content is covered.	T	3	37.5	4	50	0	0	1	12.5	0	0	4.00
		S	33	25.8	40	31.3	11	8.6	29	23	15	11	3.40
7.7	Effective teacher supervision is difficult for a large class size	T	5	62.5	3	37.5	0	0	0	0	0	0	4.63
		S	36	28	42	32.8	20	15.6	14	11	16	12.5	3.53
7.8	The method is cost intensive as equipment and apparatus involved	T	4	50	3	37.5	1	12.5	1	12.5	0	0	4.00
		S	39	30.5	41	32	12	9	19	14	17		3.52

	cost a lot of money.												
7.9	It may not achieve much in imparting organized body of knowledge into learners.	T	0	0	4	50	0	0	3	37.5	1	12.5	2.88
		S	42	32.8	40	31.3	11	8.5	22	17	13	10	3.59

Note: SA = Strongly Agree A= Agree LA= Less Agree DA – Disagree

SDA = Strongly disagree M = mean

Table 7. shows the extent of secondary school physics teachers' awareness about the advantage of using SMT physics . The table shows that most teachers (62.5%) agree that SMT physics equips the learner to be the builder of his/her knowledge through active participation and leads him /her to become problem solver. The rest (37.5%) also strongly agree and none of the teachers disagree with the merit of the teaching method. The students response also support the teachers idea in which 54.6%were strongly agree and 34.4% agree with the given statement .The table also shows that 62.5% of the teachers and 47.6% of the students and 25% of the teachers and 39.8% of the students were respectively agree and strongly agree with the statement SMT physics is student – centered.

The mean value of teachers and students (M = 4.38).and (M = 4.34) respectively show that SMT equips the learner to be the builder of his/her knowledge through active participation and leads him /her to become problem solver .The table also shows that teachers response with mean (M= 4.00) and students response with mean (M= 4.20) indicate SMT is student – centered .Likewise teachers and students with mean (M = 4.00) and(M = 3.73) respectively also indicate SMT inculcates manipulative skills of the students. Again, the mean value for teachers (M = 3.75) and for students (M = 4.00) infer SMT facilitate students' retention, recall and transfer of knowledge.

The table also shows that teachers and students responded to the statement that SMT encourages analytical thought and promotes intuitive development which results mean (M = 413) and (M = 3.92) respectively. SMT physics also responded both with teachers.(M = 4.00) and students (M = 3.40) that it is slow and time consuming method and so less content is covered. Effective teacher supervision is difficult for a large class size (M = 4.63) responded by teachers and (M = 3.53) responded by students. The method is cost intensive as equipment and apparatus involved cost a lot of money (M = 4.00) infer for teachers whereas (M = 3.52) for students. The table shows teachers(M = 2.88) and students (M = 3.59) indicate that SMT may not achieve much in imparting organized body of knowledge into learners.

However weighted mean of both the teacher's response M = 3.97 and student's response (M = 3.82) which would be rated to 79.4% and 76.4% respectively implies both the teachers and students agree that using SMT as classroom instruction would have advantages listed in the table 7.

Table 8.- Teachers and students response about physics student's textbook content with respect to the utilization of SMT

No	Student's physics textbook contents	Respondents	Response		M
			Yes	No	
8.1	The exercises given in the text are designed to analyze physics concepts using SMT	T	4	4	1.5
		S	94	34	1.73
8.2	The activities given in the textbook invite students to apply SMT	T	6	2	1.75
		S	98	30	1.77
8.3	The sequence of the units and topics are in the appropriate order to apply SMT	T	4	4	1.50
		S	89	39	1.70
8.4	The contents in the text can be covered with in the academic year by regularly using SMT	T	2	6	1.25
		S	70	58	1.55
8.5	The textbook is prepared in simple English so that the students can understand physics concepts to apply SMT	T	6	2	1.75
		S	96	32	1.75
8.6	The examples given under each topic are clear and enough to apply SMT	T	5	3	1.63
		S	91	37	1.71
8.7	The textbook contains graphs and tables to illustrate some relationship of physical quantities so that students can use it in SMT	T	8	0	2.00
		S	86	42	1.67
Weighted Mean of teachers' response, M =1.62(54.3%) Weighted Mean of students' response =1.69(56.3%)					

Table8. Shows the extent of secondary school physics teachers' awareness about physics student's textbook content with respect to scientific method of teaching. It can be inferred from the table that the calculated weighted mean of both teachers and students 1.62(54.3%) and 1.69(56.3%) respectively show they positively accept the statements given about students text book in relation to SMT physics. This means the student's textbook contents are appropriate to use SMT.

Table 9-Cheklist data collected from both teachers and students to examine teachers and students' interest to use the SMT as classroom instruction.

No	Statement	Respondents	Response			
			Yes		No	
			No	%	No	%
9.1	Are you interested in SMT Physics?	T	5	62.5	3	37.5
	Are you interested in SML Physics?	S	91	71.1	37	28.9
9.2	Are you often plan to use SMT in your lesson plan?	T	2	25	6	75
	Are your physics teacher often plan to use SMT physics?	S	71	55.5	57	45.5
9.3	Are the topics in the student's textbook appropriate to apply SMT?	T	4	50	4	50
	Are the topics in the student's textbook appropriate to apply SML?	S	105	82	23	18
9.4	Are your students interested in SML Physics?	T	2	25	6	75
	Is your physics teacher interested in SMT Physics?	S	70	54.7	58	45.3
9.5	Is your class size influences SMT/SML?	T	3	37.5	5	62.5
		S	31	24.2	97	75.8

Table 9 shows that 62.5% of secondary school physics teachers responded as they were interested in SMT physics whereas 37.5% were not interested in the method .

Again the table also shows that , 71.1% of Secondary school students were interested in the method and 28.9% were not interested in it. From the table secondary school teachers response to the statement whether the teacher often plan to use SMT physics or not indicates that , 75% were not Plan to use SMT but 25% respond as they plan to use SMT as classroom instruction. The teachers also respond to the question whether the topics in the students physics textbook appropriate to apply SMT,50% of them were agree with the statement. The table also indicates that 75% of the teachers agree with students were not interested in SMT but only 25% agree with the statement which opposes students response in the first item of the table. The last item of the tableinform that both teachers and students 62.5%and 75.8% respectively respond that students class size did not influence to use SMT as classroom instruction

Table 10 : Researcher's classroom observation checklist result.

R. No	Questions	Yes		No	
	Statements	Yes		No	
		No	%	No	%
10.1	Is the topic appropriate to use SMT?	8	100	0	0
10.2	Does the classroom size matter to use SMT?	0		8	100
10.3	Is the duration of the period enough to implement SMT	8	100	0	0
10.4	Does the teacher use other active learning methods?	2	25	6	75
10.5	Does the teacher give students individual or group work activity?	3	37.5	5	62.5
10.6	Does the teacher invite some students to present some points of their group work to the class?	0	0	8	100
10.7	Does the teacher plan to use SMT on his daily lesson plan?	0	0	8	100

Table10. Indicates that the topics that physics teachers use during observation were 100% appropriate to use SMT as classroom instruction. But the number of students in the class did not matter to implement SMT. The duration of the period is also enough but none of the teachers did not plan to use SMT in their daily lesson plan. The table also shows that only 37.5% of the teachers give group work activity.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The findings from the study indicate that optimum utilization of SMT as physics classroom instruction can be attributed to a number of reasons. First and foremost, most of the physics teachers,37.5% strongly agree with that SMT as time consuming method. What this means is that these teachers only focus on textbook portion coverage rather than students subject matter performance. On the other side the data shows that 50% of the teachers always use lecture method and 25% often use lecture method which accounts together 75%.This means that , classroom interaction–the disposition of teachers and students during instruction dialogue, seemed to be mostly teacher-centered and tended not to support inquiry-based teaching and learning which is noted for promoting conceptual change and enhance performance. The traditional way of teaching where teacher decides on what goes on in the classroom a limited advantage has in science classrooms, particularly physics. This may have negative effect on student performance. The data discussion indicate that, 62.5% of the secondary school teachers rarely and never use SMT as classroom instruction. But 62.5of them were interested in the method and 71% of the students were interested in SMT

The weighted mean value of teachers and students for students textbook checklist 1.62(54.3%)and 1.69(56.3%) respectively told us that the students textbook content were appropriate for the application of SMT as classroom instruction.

5.2 recommendations.

The research indicated that secondary school physics teachers always use lecture method of teaching than scientific method for teaching physics. It is therefore recommended that teacher education programs may emphasize scientific teaching method and in-service teachers should be provided training or refresher course to enable them to use scientific method of teaching.

- It is recommended that secondary school teachers should make effort to acquire more knowledge on various ways by which scientific method of teaching science in general and physics in particular could be applicable. This could be done by ensuring that seminars and workshops are frequently attended from time to time.

- Teachers always should ensure that whatever knowledge acquired at such seminars and workshops should be regularly put into practice to ensure mastery. Teachers are also encouraged to update their knowledge on the use of the internet so as to be getting latest information on science related issues.
- Government at all levels should ensure that seminars and workshops are not only organized but should be handled by professionals in science for teachers in secondary schools
- More Researches are recommended to compare SMT and other interactive methods of teaching physics.
- Classroom teachers are advised to use teaching methods and activities as scientific method (question and answer, discussions) which can be either for small group or whole class.
- Students should be encouraged to participate fully in the learning process.
- Classroom teachers are advised to encouraging students to use SML in constructing their own knowledge to improve students understanding and learning.
- Physics teacher must be vast in knowledge and open to new-learning opportunities to enhance his teaching style and methods. Method adopted should help the teacher motivate and sustain student's interest in Science.
- Physics teachers should acquire skills in the use of media facilities and Information Communication Technology (ICT) in the teaching of physics in Secondary Schools
- Physics teacher should not only be knowledgeable in subject matter but provide an atmosphere of warmth, friendship, love and affection to promote a conducive learning environment for students
- School directors and department head must follow up whether or not physics teachers plan to use SMT as classroom instruction.

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APPENDIX A

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

SCHOOL OF APPLIED AND NATURAL SCIENCE

DPARTMENT OF PHYSICS

Teacher's Questionnaire

Dear Teacher,

This questionnaire is designed to find out the optimum utilization of the scientific method in teaching/learning physics in secondary school. It is one of the instruments which the researcher uses to gather the necessary data for his MSc Thesis in the teaching of physics.

Thus, I kindly request you to give the required information provided. Your contribution is highly important for the success of this study. The researcher would like to assure you that all the responses you give will be kept confidential and used only for the research purpose.

Thank you in advance

The researcher

Direction 1: Personal Information Please give information about yourself for each of the categories below. Put a tick (√) mark in the appropriate box where necessary.

1.1. Name of the school ___________________________

1.2. Age: a) 21-30 ☐ b) 31-40 ☐ c) 41-50 ☐ d) 51 and above ☐

1.3. Se x: a) Male ☐ b) Female ☐

1.4. Field of study: Major____________________ Minor ______________

1.5. Qualification: a) diploma ☐ b) BSc ☐ c) MSc ☐ d) Other (specify)

1.6. Total years of teaching experience:

a) Five and less than five years ☐ b) 6-10 year ☐ c) 11-20 years ☐

d) More than 20 years ☐

1.7. Your teaching load in periods per week

a) 10 and less than 10 ☐ **b**) 11-15 ☐ c) 16-20 ☐ d) above 20 ☐

1.8. Average number of students in one class

a)30 and less than 30 ☐ b) 31-40 ☐ c) 41-50 ☐ d) 51-60 ☐ e) above 60 ☐

yDirection Two: Given the following teaching methods in physics instruction. Please indicate the extent to which you carry out these methods in your physics class lesson presentation in secondary school by putting a tick (√) in one of the column against each method.

R.No.	Teaching method	**Rating Scale**				
		Always	Often	Sometimes	Rarely	Never
2.1	Lecture method					
2.2	Demonstration method					
2.3	Problem solving method					
2.4	Group discussion method					
2.5	Experimental method					
2.6	Scientific method					
2.7	Observation method					
2.8	Assignment method					

Please specify if you use other methods of teaching____________________________________

Direction Three: The following statements are supposed to specify the scientific method of teaching physics at secondary school. Please indicate the extent of your agreement by putting a tick (√) in one of the column against each statement

5. Strongly agree 4. Agree 3. Less Agree 2. Disagree 1. Strongly disagree

R.No	Statement	1	2	3	4	5
3.1	Equips the learner to be the builder/owner of his knowledge through active participation and leads him to become problem solver.					
3.2	Instruction is student – centered					
3.3	inculcates manipulative skills.					
3.4	Retention, recall and transfer of knowledge is facilitated					
3.5	Encourages analytical thought and promotes intuitive development.					

3.6	It is slow and time consuming method and so less content is covered.					
3.7	Effective teacher supervision is difficult for a large class size					
3.8	The method is cost intensive as equipment and apparatus involved cost a lot of money.					
3.9	It may not achieve much in imparting organized body of knowledge into learners.					

Please write some points you like to comment about the scientific method of teaching physics.

____

____

Part Four-Textbook Analysis

The following check-list are designed to analyses physics textbook content to apply scientific method of teaching. Put tick (√) mark for your response under Yes/No options.

R. No	Statement	Yes	No
4.1	The exercises given in the text are designed to analyze physics concepts using SMT		
4.2	The activities given in the textbook invite students to apply SMT		
4.3	The sequence of the units and topics are in the appropriate order to apply SMT.		
4.4	The contents in the text can be covered with in the academic year by regularly using SMT		
4.5	The textbook is prepared in simple English so that the students can understand physics concepts to apply SMT		
4.6	The examples given under each topic are clear and enough to apply SMT		
4.7	The textbook contains graphs and tables to illustrate some relationship of physical quantities so that students can use it in SMT		

Part Five-Reasoning

The following Yes/No questions are designed to answer. Please put a tick (√) mark for the Yes/No questions and write your reason for your response on the blank space provided.

5.1.Are you interested to apply SMT Physics? Yes ☐ No ☐

If your answer is yes, what makes you interested in? ______________________________

____ .

If your answer is No, Why?____

____

5.2.Are you often plan to use SMT in your lesson plan? Yes ☐ No ☐

Reason out your answer.

____

____

5.3.Are the topics in the students textbook appropriate to apply SMT? Yes ☐ No ☐

If your answer is No, what makes it inappropriate?

____

____.

5.4.Are your students interested in SML Physics? Yes ☐ No ☐

If No, Why?

____

____

5.5.Is your class size influences SMT? Yes ☐ No ☐

If Yes, how?

____

APPENDIX B

ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

SCHOOL OF APPLIED AND NATURAL SCIENCE

DPARTMENT OF PHYSICS

Student's Questionnaire

Dear Teacher,

This questionnaire is designed to find out the optimum utilization of the scientific method in teaching/learning physics in secondary school. It is one of the instruments which the researcher uses to gather the necessary data for his MSc Thesis in the teaching of physics.

Thus, I kindly request you to give the required information provided. Your contribution is highly important for the success of this study. The researcher would like to assure you that all the responses you give will be kept confidential and used only for the research purpose.

Thank you in advance

The researcher

Part 2

Direction one: Personal Information .Please give information about **yourself** for each of the categories below. Put a tick (√) mark in the appropriate box where necessary.

1.1. Name of the school ___________________________ Grade & Section ______________

1.2. Sex: a) Male ☐ b) Female ☐

1.3.Age: a) 12-16 years ☐ b) 17-20 years ☐ c) 21 and above years ☐

Direction Two: Given the following teaching methods in physics instruction. Please indicate the extent to which your teacher carries out these methods in your physics class lesson presentation in secondary school by putting a tick (√) in one of the column against each method.

R.No.	Teaching method	**Rating Scale**				
		Always	Often	Sometimes	Rarely	Never
2.1	Lecture					
2.2	Demonstration					
2.3	Problem solving					
2.4	Group discussion					
2.5	Experimental					
2.6	Scientific					
2.7	Observation					
2.8	Assignment					

Please specify if your physics teacher uses other methods of teaching____

____

Direction Three: The following statements are supposed to specify the scientific method of learning(SML) physics at secondary school. Please indicate the extent of your agreement by putting a tick (√) in one of the column against each statement.

5.srongly agree 4. agree 3.Less Agree 2. disagree 1. strongly disagree

R.No	Statement	1	2	3	4	5
3.1	Equips the learner to be the builder/owner of his knowledge through active participation and leads him to become problem solver.					
3.2	Instruction is student – centered					
3.3	inculcates manipulative skills.					
3.4	Retention, recall and transfer of knowledge is facilitated					
3.5	Encourages analytical thought and promotes intuitive development.					
3.6	It is slow and time consuming method and so less content is covered.					
3.7	Effective teacher supervision is difficult for a large class size					
3.8	The method is cost intensive as equipment and apparatus involved cost a lot of money.					
3.9	It may not achieve much in imparting organized body of knowledge into learners.					

Part Four-Textbook Analysis

The following check-list questions are designed to analyze physics textbook content to apply scientific method of teaching. Put tick (√) mark for your response under Yes/No options.

R. No	Statement	Yes	No
4.1	The exercises given in the text are designed to analyze physics concepts using SML		
4.2	The activities given in the textbook invite students to apply SML		
4.3	The sequence of the units and topics are in the appropriate order to apply SML		
4.4	The contents in the text can be covered with in the academic year by regularly using SML		
4.5	The textbook is prepared in simple English so that the students can understand physics concepts to apply SML		
4.6	The examples given under each topic are clear and enough to apply SML		
4.7	The textbook contains graphs and tables to illustrate some relationship of physical quantities so that students can use it in SML		

Part Five- Reasonout your response.

The following Yes/No questions are designed to answer. Please put tick (√) marks for the Yes/No questions and write your reason for your response on the blank space provided.

5. 1.Are you interested in SML Physics? Yes ☐ No

If your answer is yes, what makes you interested in? ______________________________

____ .

If your answer is No Why?

____

____

5.2.Does your teacher often plan to use SMT in his/her lesson plan? Yes ☐ No ☐

Reason out your answer.

____

____

5.3.Are the topics in the students textbook appropriate to apply SML physics? Yes ☐ No ☐

If your answer is No, what makes it inappropriate?

____

____.

5.4.Are your teacher interested in SMT Physics? Yes ☐ No ☐

If No, Why?

____

____

5.5.Is your class size influences SMT? Yes ☐ No ☐

If Yes, how? ____

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APPENDIX C

Physics classroom observation checklist format

Name of the school ____

Date _________ Teacher's code _______ Grade & section _________

Period _______ Shift _______ Duration of the period ________

Topic ____

The following physics classroom observation Yes/No questions are given. Therefore, the classroom observer (the researcher) is going to mark a thick (√) for each question under Yes/No

Write here under other observation results if any.

R. No	Questions	Yes	No
1	Is the topic appropriate to use SMT?		
2	Does the classroom size matter to use SMT?		
3	Is the duration of the period enough to implement SMT		
4	Does the teacher use other active learning methods?		
5	Does the teacher give students individual or group work activity?		
6	Does the teacher invite some students to present some points of their group work to the class?		
7	Does the teacher plan to use SMT on his daily lesson plan?		

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