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DEPARTMENT OF SCIENCE EDUCATION

EFFECT OF COMPUTER ASSISTED INSTRUCTION ON STUDENTS' PERFORMANCE IN SELECTED TOPICS IN MECHANICS.

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DISSERTATION SUBMITTED TO THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE EDUCATION, TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER OF EDUCATION DEGREE IN SCIENCE EDUCATION OF THE UNIVERSITY OF EDUCATION, WINNEBA.

DECEMBER 2015

DECLARATION

STUDENT'S DECLARATION

I, Hillary Elorm Akposu, declare that this dissertation with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

HILLARY ELORM AKPOSU

Date

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this dissertation was supervised in accordance with the guidelines on supervision of thesis laid down by the University of Education, Winneba.

DR. ISHMAEL ANDERSON

(SUPERVISOR)

Date

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DEDICATION

To my beloved parents, Mr. and Mrs. Akposu, I dedicate this work.

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ABSTRACT

The objectives for this study were to determine the effect of computer assisted instruction based on constructivist theory approach over traditionally designed instruction on second year students of Afife Senior High Technical School in some selected topics in mechanics. Random sampling was used to select sample size of fifty (50) students. The total sample size was made up of twenty-seven (27) boys and twenty-three (23) girls.

Test (pre-test and post-test), observation and interview were the main instruments used for collecting data. Data obtained from the tests were analysed using t-test to find out the level of achievement of students after using computer assisted instruction (CAI) in selected topics in mechanics.

Analysis of the post and pre-test scores showed that there was a significant difference in the performance of the students after the intervention activities. This implies that the intervention activities had positive effects on the achievement of students. Therefore, computer assisted instruction is an effective teaching strategy. It was also showed that with the use of computer assisted instruction, knowledge is constructed and this causes students to have more interest towards science as a school subject.

CHAPTER ONE

INTRODUCTION

2.0 Overview

The study investigated the effect of computer assisted instruction on the performance of students in some selected topics in mechanics. This chapter discusses the use of computer assisted instruction in Ghanaian classrooms and the benefits derived from effective use of computer assisted instruction. It includes statement of the problem, purpose of the study and the questions that guided the study. The significance of the outcome of the study, the limitations and delimitations of the study were discussed in this chapter.

1.1 Background to the Study

Advances in computer technology have caught the attention of many educators and researchers (Varank, 2005). Varank (2005) is of the opinion that computer-based multimedia applications, because of their flexible and varied presentation capabilities, are considered as an effective alternative to traditional training methods. Hence, today in many educational and training settings, interactive computer programs are used to teach young students and adults computer literacy skills (Varank, 2005).

In Altun, Yiğit and Alev (2007) study, it was stated that the reason for not reaching the aims in the lessons involving abstract concepts like Law of Snell in Physics was because of the application of traditional approaches. In their study based on similar studies in the field of educational research, computers and computer supported material were used in order to find solutions to this problem. In addition to other applications, their study was assumed that computer supported material can be used for making abstract concepts concrete in teaching physics. In this study, the software with simulations adopted may be seen to be close to real life situations. With this software, it is aimed that the students would learn in effective and permanent way, be active learners, form their own knowledge, learn to think and develop a positive attitude towards physics (Altun, Yiğit & Alev, 2007).

Computer-based learning has the potential to facilitate development of students' decision-making and problem-solving skills, data-processing skills, and communication capabilities. By using computer, students can gain access to expansive knowledge links and broaden their exposure to diverse people and perspectives (Berson, 1996).

Many studies in the published literature indicate that there is a strong relationship between the use of computers and students' academic achievements in teaching and learning processes (Yigit, 2005; Altun, Yigit & Alev, 2007). For instance, Yiğit (2005) found in a study that computer assisted instruction has had positive impact on students' perceptions about computer supported instruction as well as their academic achievement.

The use of computer in the classroom has given rise to computer assisted instruction software packages for classroom instructional purposes. According to Umaru (2003) computer assisted instruction is a program of instruction or package presented as computer software for instructional purpose. Therefore, the position of science makes it necessary for the use of innovative pedagogical strategy that will enable teachers meet the challenges of teaching and learning of the subject especially in this era of information age. Several researches have shown that using computer assisted instruction (CAI) has a positive effect on students achievement compared to traditional methods (Okoro & Etukudo, 2001; Paul & Babaworo, 2006; Egunjobi, 2002). According to Ezeliora (2002) the use of Computer-Assisted Instruction (CAI) provides the learner with different backgrounds and characteristics. Using teaching software such as computer assisted instruction (CAI), concepts are presented to the students in such a well-organized manner that makes for greater clarity and easier understanding. Okoro and Etukudo (2001) found computer assisted instruction (CAI) for teaching chemistry, Paul and Babaworo (2006) in technical education courses, Egunjobi (2002) in geography and Karper, Robinson, and Casado – Kehoe (2005) in counseling education; they all confirmed that computer assisted instruction (CAI) seen to be effective in enhancing students' performance in other subjects than the conventional classroom instruction. Looking at gender of student in terms of performance at secondary school level Ash (2005), Basturk (2005) and Dantala (2006) found no significant difference between male and female students taught, physics and history respectively using computer-assisted instructional package.

According to Russell (2004) teachers are expected to provide assistance, equip the students, provide the techniques involved and at the end clarify students' worksheet. Hence, science teachers should be involved using computer assisted instruction.

1.2 Statement of the Problem

A good academic performance is the ultimate goal of every educational establishment. The performance and interest of students keep declining in science in schools, especially Afife Senior High Technical School and there is the need to improve on the performance as well as the interest in science. It is a common knowledge that traditional instructional method has been in use for quite a long time yet performance and interest continue to decline in science. New and modern ways of presenting instruction in classroom need to be assessed and used properly. Computer assisted instruction is deemed to be one of the modern ways of presenting instruction.

Studies show that changes to courses, curricula and instructional methods, or in some cases, the contemplation of changes, have been driven by concerns about traditional teaching methods McDermott (2001); Meltzer (2005). Other researchers are also of the opinion that traditional instructional methods are not the most appropriate for teaching physics to all students and do not make the best use of advanced technologies and a decline in the number of students choosing physics as a major field of study (Maloney, O'kuma, Hieggelke & Heuvelen, 2001; Pollock, 2009; McBridge, Zollaman & Rebello, 2010).

Advancing technology has opened many doors in science education. The use of computer based teaching in science provides number of alternatives to students such as visualization of abstract concepts that will foster student understanding (Meltzer & Manivannan, 2002). These alternatives would be complementary to traditional teaching. Computer assisted instructional materials are more effective in developing favorable attitude, and in capturing interest towards learning physics (Azar & Şengüleç, 2011). The activities that aid students' visualization of abstract concepts will foster their conceptual understanding. These activities would be complementary to traditional teaching, and could be concrete physical activities, or computer simulations and animations (Fraser, Pillay, Tjatindi, & Case, 2007; Bayrak, 2008; Serin, 2011). In recent years, it is shown that computer technology developed rapidly and its reflection of computer assisted education are more effective on students' achievement than traditional methods. Especially, to support physics laboratory and to teach physical topics more easily, computer programs such as interactive physics, Physics education technology (Phet) interactive simulation, Crocodile Physic, Edison 4.0 and Virtual Labs are prepared. Using these programs in physics education is more useful on students' achievement than traditional teaching methods (Geban, Askar & Özkan, 1992; Şengel, Özden & Geban, 2002).

This therefore, justifies the need for the study of the effect of computer assisted instruction on the performance in selected topics in mechanics.

1.3 Purpose of the Study

The main purpose of this study was to investigate the effect of computer assisted instruction based on constructivist theory approach on the performance of students and to explore the use of computer assisted instruction to improve the performance of students in some selected topics in mechanics in Afife Senior High Technical School.

1.4 Research Objectives

The objectives of the study were to:

1. determine the knowledge level of students in those selected topics in mechanics before the use of computer assisted instruction.

2. determine the knowledge level of students in those selected topics in mechanics after the use of computer assisted instruction.

3. determine the interest of students in those selected topics in mechanics after the use of computer assisted instruction.

1.5 Research Questions

The following research questions were pursued.

1. What is the knowledge level of students in those selected topics in mechanics before the use of computer assisted instruction?

2. What is the knowledge level of students in those selected topics in mechanics after the use of computer assisted instruction?

3. What is the interest of students in those selected topics in mechanics after the use of computer assisted instruction?

1.6 Significance of the Study

The outcome of this study would serve as a reference for those who wish to carry out research into similar issues on how well science is taught and learnt in schools and enable science educators, subject advisors, curriculum designers and developers realize the effect of computer assisted instruction on the performance in some selected topics in mechanics.

It is also hoped that the outcome of the research would enable teachers and administrators improve students' interest and understanding of force, motion and pressure concepts and science in general in Afife Senior High Technical School. Hence its adoption will foster teaching and learning of integrated science.

1.7 Delimitations

The study was conducted in only one selected school. In this selected school, only form two students were considered. Besides, the researcher would have wished to use all the Senior High Schools in the district. This would have afforded him the opportunity to compare varied results and present wider assessment of the problem at hand. The study was restricted to only one school due to time tabling of individual schools.

1.8 Limitations

The duration for the study was a short one. A longer period of study may have improved on the richness of data obtained. Since respondents knew that they were being studied, the information provided were only the reflection of the Afife Senior High Technical School respondents. Also, some students were truant and so were not in school throughout the period and therefore, generalization of the findings must be done with caution.

1.9 Organization of the Study

This write-up is divided into five chapters. Chapter one deals with the introduction under which the background of the study, statement of the problem, purpose of the study, research questions, significance of the study, limitations and delimitations. In chapter two, literature that is relevant to the research was reviewed. The third chapter also indicates the methodology that were used to gather the necessary information about the issues raised in the study and this are the research design, population, sample and the sampling technique, the research instrument for collecting the data, reliability and validity of instruments, pilot study of instruments, the method of data collection, data analysis and intervention procedures. Chapter Four, deals with the discussion and presentation of results. Chapter Five discusses the findings and looks at conclusion, recommendations and suggestions.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter discusses some literature that relate to this study. It begins with the theoretical framework that underpins the study. It is continued with the discussion of how computers and computer assisted instruction have been integrated in education, and its impact on the learning processes, as well as the teacher involvement in the use of computer assisted instruction. The chapter continues with some reasons for improving students' knowledge and understanding as well as effect of computer assisted instruction on laboratory practices vis-a-vis traditional instructional method. The chapter has a discussion on the constructivist view of human learning. Traditional and constructivist methods of teaching are at the tail end of this chapter.

2.1 Theoretical framework

This research has its theoretical bases on the constructivist learning theory. Constructivist teaching hinges on the constructivist learning theory. Constructivism in science education is underpinned by a philosophy that all learning is constructed and that new knowledge is built upon the prior experiences of the learner (Naylor, 1999; Kruckeberg, 2006). The foundation of constructivism is attributed to the work of Dewey, Piaget and Vygotsky who maintain that how students respond to new learning situations is influenced by their prior knowledge (Hyslop-Margison & Strobel, 2011). This philosophy of constructivist teaching might have influenced a change in science curriculum and instruction to take into account students' experiences. Fox (2001) asserts that the foundation of constructivism is based upon the idea that learning is not passively absorbed. It is an active process in which knowledge is both invented and personal to the learner (Fox, 2001). The key for learning is fundamentally linked to the active participation of the learner. New knowledge can only be constructed by linking meaning to the learner's previous, existing knowledge (Naylor, 1999).

Abdal-Haqq (1998) is of the opinion that constructivism gives teachers another angle to look at how students learn and to focus on process and to provide suitable ways of documenting change and transformation. It also serves as a reminder to teachers to look for different ways of engaging individual students, develop rich environment for exploration, prepare coherent problem sets and challenges that focus the model building effort, elicit and communicate students perceptions and interpretations (Abdal-Haqq, 1998).

Ultanir (2012) argues that some aspects of the pedagogy of Dewey, Piaget and Montessori share some commonality in regards to the knowledge learning process of a child. Each of them agrees that the acquisition of knowledge and learning is about constructing meaning as opposed to passive reception. An individual's process of developing new knowledge is affected by previously acquired knowledge.

Constructivist again maintain that individuals construct or create their own new understandings or knowledge through the interaction of what they already know and believe and the ideas, events, and the activities with which they come into contact (Richardson, 1997). The settings of a constructivist learning environment is characterized by, engagement, inquiry, problem solving, and collaboration with others. The teacher in such an environment serves as a guide, facilitator, and co-explorer who encourage learners to question, challenge, and formulate their own ideas, opinions, and conclusions de-emphasizing “correct” answers and single interpretations (Ismat, 1998).

Several publications cite the importance of teachers' modeling constructivist approaches that engage students in interdisciplinary exploration, collaborative activity, and field-based opportunities for experiential learning, reflection, and self-examination (Kaufman, 1996; Kroll & LaBosky, 1996) if future teachers are to be able to employ these strategies in schools.

Piaget (1977) suggests that learning occurs through the construction of meaning rather than through passive reception. According to Piaget, when a student is confronted with new information, the learner performs the functions of assimilation and adaptation. The learner compares this information with knowledge that already exists in his/her mind. If the old information does not conform to the new, the learner reorganizes his/her mind with respect to the new information. Thus a learner’s cognitive development can be said to be continues effort.

2.2 History of Integration of Computers and Computer Assisted Instruction into Education

The idea of using technology to enhance education has been around for a long time. Back in 1928, courses began being offered through radio. These classes were for enrichment or credit and were centered in Ohio and Wisconsin (Clark, 1983). With the introduction of television in 1932, the University of Iowa began experimenting with offering classes using this technology. Several years later in 1944 computers made their first appearance with the invention of the MARK I; a large mainframe used primarily in performing mathematics and science calculations (Molnar, 1997).

According to Molnar (1997) using television as an educational tool slowly began to grow and in the 1950s, seventeen educational programs started using television as a way to reach their students and twenty-two years later there were at least 233 educational stations. Throughout this time period, computers began to filter more into the education world and in 1959 at the University of Illinois the first large scale use of a computer assisted instruction (CAI) system, PLATO, was introduced (Molnar, 1997).

During technology transitioned in the early seventies, universities began installing microwave networks to create close-captioned classes for students at remote locations. Computer assisted instruction (CAI) systems continued to be developed throughout this time period, but lessons were dull and uninspired (Minoli, 1996) and 50% to 60% of the material in the lessons was extraneous (Saettler, 2004). For this reason, through the eighties, about 95% of public television stations and one third of universities continued to offer distance learning courses through the Adult Learning Service (ALS) using television. Still, the use of computers continued to grow and by 1975, 23% of schools were using them for educational purposes and 55% of schools at least had access to them (Molnar, 1997).

It was not until the nineties, when computers took on a newer, more efficient structure, became faster and more multifunctional society really began to consider their potential in education (Harting & Erthal, 2005). During this period, schools purchased around two million computers, resulting in almost 100% of educational institutions using this technology in their buildings (Cotton, 1991). Out of need, the Virtual High School Global Consortium was created in 1996 and by 2009 over 1,000,000 students enrolled in at least one online class. (Picciano, Seaman, Shea & Swan, 2012). By the beginning of the twenty-first century, computers were fully implemented into schools and being utilized in a variety of ways.

2.3 Impact of Computer Assisted Instruction on Learning

According to Thomas and Tall (1998) a goal of education is to help students learn and to measure this learning, assessments are commonly used. Several studies have been done to determine if a relationship exists between computer assisted instructions (CAI) and learning and long term retention. One such study involved 11 and 12 year old students using an interactive algebra program (Thomas & Tall, 1998). One year after completing the study, both experimental and control groups were retested using the original posttest. Students who used computer assisted instruction (CAI) scored significantly higher than students in the control group supporting other research studies (Barrow & Markman, 2009; Burch & Kuo, 2010). Conflicting evidence has been presented in other studies that students who used computer assisted instruction (CAI) either had no significant difference in posttest scores or scored lower than students receiving traditional lessons (Linden, 2008; Santally, Boojawon, & Senteni, 2004).

In one study involving 33 college students, both control and experimental groups had similar mean test scores, but students working with interactive computer assisted instruction (CAI) scored higher on tests involving transfer of concepts (Evans & Gibbons, 2007). A different experiment split 115 third-grade students into two groups to learn about fire safety (Chuang & Chen, 2009). The control group was exposed to text-based instruction on a computer, while the experimental group played a real time computer game with identical information. While no significant difference was observed on matching questions between experimental and control groups on the posttest, the experimental group scored significantly higher on multiple choice and application questions. Raised cognitive levels appeared to be a result of computer assisted instruction (CAI) with high interactivity in the form of a computer game (Chuang & Chen, 2009; Squire, DeVane, & Durga, 2008). Regardless of age or education level, high interaction between user and computer seems to increase differentiation and recall, promote problem solving skills, enhance comprehension and encourage higher level cognitive thinking (Chuang & Chen, 2009). Levine and Donitsa-Schmit (1998) compared the traditional learning strategies with computer-based activities. Applications and the assessment were administered after the students were distributed into control and experimental groups. The results of the evaluations showed that the experimental group was more successful at answering the questions of the Chemistry Achievement Test than the control group. In another study, Demircioğlu and Geban (1996) compared computer assisted instruction (CAI) with the traditional teaching method on 6th grade students in science classes. The students of the experimental group were taught with CAI in addition to the traditional teaching method. The students of the control group were taught through problem solving. The topics were static electricity, electrical transmission, electrical wires and Ohms laws. The science achievement rates of the two groups were compared through a t-test and the group that was taught through CAI was found to be more successful. The effects of the computer assisted instruction (CAI) were assessed by Gerardo (1986). This study compared the effectiveness for learning of the technology-assisted and the traditional method. The students were shown to be more successful in the technology-assisted applications. In another study, the achievement rate increased when the general chemistry applications were made through the CAI (Jackman, Moellenberg, & Brabson, 1990).

Lord (1999) in a study of 90 high school students observed that they had difficulty in understanding the nitrogen cycle and experienced misconception problems when they were taught through traditional methods.

The students were then distributed into a control and experimental group. The control group was taught through the traditional method with teacher-centered education using models, slides, and the students were not allowed to ask any questions. The experimental group was taught in groups using the question and answer method in an active way. It was reported that the achievement rate of the treatment group was higher.

In addition to improved test scores and learning, computer assisted instruction (CAI) has impacted students in unexpected ways. Users of computer assisted instruction (CAI) demonstrated increased computer self-efficacy, an individual's perception of their computer skills and knowledge (Moos & Azevedo, 2009; Chapman, 2000), raised self-regulatory skills (Shen, Lee, & Tsai, 2008) and increased motivation (Hannafin & Foshay, 2008).

In computer assisted instruction (CAI), the teacher can use computers at different times and places according to the characteristics of the subject matter, the students, and the available software and hardware. Computer programs can be used for practice, revision, one-to-one instruction, problem solving, or simulations during the applications (Demirel, 1996). In many studies, computer assisted instruction (CAI) has been shown to have some benefits, although there are also cases where none were observed. With computer assisted instruction (CAI), there is a form of one-to-one instruction (or two students together at each computer), plus the opportunity for the students to proceed at their own pace, repeating parts of the exercise as they wish. None of these features are easily available in a didactic classroom situation.

2.4 Teacher Involvement in Computer Assisted Instruction

Teachers have an impact on the effectiveness of computer assisted instruction (CAI) on students learning content in the classroom. Solely using technology as a tool to deliver information will “not influence student achievement any more than the truck that delivers our groceries causes change in nutrition (Clark, 1983). Yet, our nutrition can be damaged by a bad choice in delivery methods (Li & Ma, 2010). In order for teachers to be effective, teachers must use research to understand the link between technology and how students learn mathematics and science. (Ozel, Yetkiner, & Capraro, 2008). Not only does professional development need to be available, but teachers need to be active participants to make computer assisted instruction (CAI) effective for their students (Cavalluzzo, Lowther, Mokher, & Fan, 2012).

Azar and Şengüleç, (2011) were of the opinion that one of the main purposes of the physics education is to raise scientifically literate individuals so that there will be a strong relationship between science and technology. According to these authors, in order to gain individuals with higher order cognitive process skills and to increase creativity of them, physics education should be technologically based. In this process, teachers have an important role to transfer technological innovations to aim at productivity in physics education to the instructional implementations. For this reason, they were of the opinion that technology is the effective tool while a teacher developing the scientific literacy. They further indicated that qualified physics teacher should have the ability of understanding physics, considering the importance of physics in the future, comprehending the relation of science, society with technology, and also understanding negative and positive effects of them on each other (Azar & Şengüleç, 2011). Yet, according to a research, lots of teachers are either not aware of technological devices or do not use effectively these technological devices especially computers although they can easily access the technology and technological devices (Francis- Pelton & Pelton, 1996). The majority of teachers believe the advantage of using computers and other technological devices in physics education. But, they are not volunteered users of them since some teachers have not experience about using technology, positive attitude towards technological devices and self-confident (Rohmer & Simonson, 1981; Okebukola, 1993; McInerney, Mclnerney & Sinclair, 1994; Francis-Pelton & Pelton, 1996).

The role or impact of teachers on the performance of students in schools across all subjects can hardly be doubted. Sanders (2000) in a study concluded that "differences in teacher effectiveness are the single largest factor affecting academic growth of the population of students" (p8). According to Betts, Zau and Rice (2003), most important school resource is the teacher and the many dimensions of their training, including years of teaching experience, their official teacher certifications and subject authorizations, their highest academic degree, and their field(s) of study at college.

According to Arain (2010) the importance of teachers is widely accepted because of their impact on students' performance. Arain (2010) contended further that research has shown that improved teacher variables were most likely to produce substantial gains in students' performance. One of these teacher related variables that could lead to gains in students' performance is teachers' academic status.

Connell (1998) conducted a study over a period over one year in two rural elementary classes. The traditional teacher centered class used technology solely as a presentation tool, while the student centered classroom used technology to encourage math exploration. Both classes scored higher than other students in their school and state. However, students using technology as an exploration tool, scored significantly higher than the class using technology as a presentation tool.

2.5 Reasons to Improve Students' Knowledge and Understanding

One of the goals of science education is to improve students' knowledge and understanding of scientific concepts. The question is why should we pursue understanding? Perkins (1993) argues that knowledge and skill do not guarantee understanding and that people can acquire knowledge and routine skills without understanding their basis or when to use them. Knowledge and skills that are not understood do students little good.

Additionally, the goal of science education has always been to prepare individuals who would develop a certain level of scientific understanding after their formal education in school. These scientifically literate individuals would be capable of applying their knowledge and skills acquired in science, whenever personal or socially relevant issues demanded such understanding. For instance, by having an understanding of science contents such as Physiology, Biology, and Chemistry, scientifically literate individuals would be able to use reasons to form their opinions and draw their valid individual inferences about such health-related issues such as nutritional awareness and medicine usage, rather than being misled or duped by propaganda or positions not supported by evidence (Wang & Schmidt, 2001).

In the long term, education must aim for active use of knowledge and skill (Perkins, 1992). Students acquire knowledge and skills in school so that they can put it to a more practical use in various professions such as engineer, doctor, scientist that require appreciation, understanding and judgment.

Science concepts are important to science instruction, and students' understanding of these concepts is crucial to successful teaching and learning. It is this vain that Millar (1989) noted that without an understanding of science concepts it would be nearly impossible for students to follow much of the public discussion of scientific results or public issues pertaining to science and technology.

According to Johnstone (1991) science can be understood at three different levels, each increasingly difficult: the phenomena (macroscopic), the particle (microscopic), and the 'symbolic. For example if we consider water. Most two-year-old children can recognize and name the colorless, odorless liquid in a glass as water because they know the properties of the phenomenon water. A second way to understand water is to represent it as a collection of particles (molecules) that have attractive forces between them and that consist of the atomic particles hydrogen and oxygen. This mode of representation is certainly more complex than focusing on the physical properties of water. A third way of representing water is by using the symbols for hydrogen and oxygen to represent the formula H_20. In addition, symbolic mathematical formulas can be used to show properties of water. For example, the density of water equals mass/volume. Students with a sound conceptual understanding of water integrate these three ways of representing water into long-term memory.

Perkins (1993) ponders on the query: What is understanding? And you will realize that good answers are not obvious. To draw a comparison, we all have a reasonable conception of what knowing is. When a student knows something, the student can bring it forth upon call and tell us the knowledge or demonstrate the skill. But understanding something is a more subtle matter. A student might be able to recite reams of facts and demonstrate routine skills with very little understanding. Perkins (1993) sums it up that somehow, understanding goes beyond knowing, understanding something is a matter of being able to carry out a variety of "performances" concerning the topic.

One thing seems clear when it comes to understanding; even young children are likely to hold on to their own explanations (ideas) about the world despite what they are told in school. Unless students are faced with experiences that challenge their conceptions, they are not likely to change their conceptions of how things work or accept alternative descriptions as useful or important (Suping, 2003).

One factor which has contributed to low interest in science by students and low understanding of concepts is the method adopted for teaching and learning science. Fensham (2008) listed four views of students which contribute directly to low interest in science: Science teaching is predominantly transmissive; The content of school science has an abstractness that makes it irrelevant; Learning science is relatively difficult, for both successful and unsuccessful students; Hence, it is not surprising that many students in considering the senior secondary years are saying: Why should I continue studying science subjects when there are more interactive, interesting and less difficult ones to study?

This unhealthy development in the outlook of students towards science has sparked the search for alternative methods of science teaching and learning which can stimulate students' interest in science. Science education as a field of study is therefore in dire need of methods with qualities such as lesson clarity, promotion of self-activity, promotion of self-development, stimulation of interest and curiosity and relying on the psychological process of teaching and learning to recommend to science teachers. The methods should encourage science teaching and learning that is better than it is now.

In summary, understanding something is a matter of being able to carry out a variety of performance concerning the topic (Perkins, 1992).

2.6 The Laboratory and Computer Assisted Instruction

One of the main goals of using the laboratories in physics education is to teach students the philosophy, branches, topics, theories, laws of physics; the other one is to gain steps of the scientific method namely science process skills while learning the philosophy, branches, topics, theories, laws of physics (Azar & Şengüleç, 2011) . Tamir (1977) listed the aims of widely using laboratories in science education as follow: laboratories provide a) to get students to comprehend abstract and complex scientific concepts by using concrete materials; b) to gain students problem solving and analyzing skills by comprehending the nature of science; c) to develop practical experiences and special talents of students; d) to enjoy students with laboratory activities and by this way to develop positive attitude towards scientifically working.

According to Azar & Şengüleç (2011) laboratory education have not achieved its main goals, not provided meaningful learning, and not developed positive attitudes towards the science in recent years. As a result, today, more essential resources and time have been allocated in order to enhance the effectiveness of laboratories in science teaching both in primary and secondary education.

In recent years, it is shown that computer technology developed rapidly and its reflection of computer assisted education are more effective on students' achievement than traditional methods. Especially, to support physics laboratory and to teach physical topics more easily, computer programs such as interactive physics, Physics education technology (Phet) interactive simulation, Crocodile Physic, Edison 4.0 and Virtual Labs are prepared. Using these programs in physics education is more useful on students' achievement than traditional teaching methods (Geban, Askar & Özkan, 1992; Şengel, Özden & Geban, 2002). But, Miller (1986) did not find a significant relationship between students' biology achievement and computer assisted education or traditional teaching methods. In the study of Roth (1994) it was emphasized that the laboratory activities in science teaching were put into effect in the 1960s. However, students could not reach the desired levels by using these activities. Yager, Engen and Snider (1969) concluded that laboratory experiences are not meaningful adequately for students and therefore they do not make a significant contribution to their conceptual understanding. Renner (1986) emphasized that the importance of laboratory applications for science learning is agreed with everyone; however the actual role of the laboratories is not like this. According to Hofstein (1988) students were still performing experiments in the laboratory in a "cook-book" approach which focused on development of low level science skills. Few opportunities are provided for the students to discuss both experiment and its results, make and test hypothesizes or to design an experiment and finally perform an experiment actually. However, to overcome these obstacles, it is possible by using computer programs to form simulations and animations of experiments. Therefore, students perform these experiments on computers with the help of imaginary experiments environments formed by simulations and animations (Hofstein, 1988). Cadangonan (2004) conducted a study on the computer assisted students instruction on selected topics in Symbolic Logic. Students viewed CAI as infinitely patient, never get tired, never get frustrated or angry, allow students to work privately, never forget to correct or praise, are fun and entertaining, individualized learning, are self-paced, do not embarrass students who make mistakes, make it possible to experiment different options and build proficiency in computer use which will be valuable later in life (Cadangonan, 2004). Moreover, students receiving computer assisted instruction (CAI) also retain their learning better (Cotton, 2011).

2.7 Traditional Instructional Method

The traditional method of teaching and learning sees teachers as passing over their knowledge to their pupils (Bennett, 2003; Trowbridge, Bybee, & Powell, 2000). This view is strongly linked to expository teaching; teachers standing at the front telling their pupils about scientific ideas. One of the common teaching methods that science teachers prefer today is the lecture method. In this, the teacher transmits knowledge to the students who sit passively in the classroom and listen. Another common method is the question-and-answer approach, which was developed in order to avoid the boredom caused by lectures and to provide a more efficient learning environment. On the other hand, case studies allow the students to face the problems that occur in real life. They help to fill the gap between theory and practice through putting the previously learnt concepts and principles into use. The best part of this method is that it enables the students to apply what they have learnt to what they are living through (Sonmez, 1986).

Traditional teaching is concerned with the teacher being the controller of the learning environment. Power and responsibility are held by the teacher and play the role of instructor (in the form of lectures) and decision maker (in regards to curriculum content and specific outcome).They regard students as having 'knowledge holes' that need to be filled with information. In short, the traditional teacher view that it is the teacher that causes leaning to occur (Novak, 1998). The traditional method implies that the role played by pupils in the learning process is largely passive, and that a pupil's mind is a tabula rasa- a blank slate onto which knowledge can be written.

Learning is chiefly associated within the classroom and is often competitive. The lesson's content and delivery are considered to be most important and students master knowledge through drill and practice (such as rote learning). Content need not be learned in context (Theroux 2002, Johnson & Johnson 1991). Ajaja (2013) states the following advantages of the traditional teaching method:

1. It is easy to create interest in a topic or subject by the teacher.
2. Students easily acquire knowledge, new information, and explanation of events or things.
3. It helps students to clarify and gain better understanding of a subject, topic, matter or event.
4. Students and teachers cover more content materials within a short period of time.

The major limitation of this method is that there is relatively little student activity and involvement (Bennett, 2003; Trowbridge et al., 2000). Thus, the students are said to be passive. The limitation experienced with the transmission approach led to the development of other views of science teaching and learning.

2.8 The Constructivist View of Human Learning

Constructivism is an epistemological view of knowledge acquisition emphasizing knowledge construction rather than knowledge transmission and the recording of information conveyed by others. The role of the learner is conceived as one of building and transforming knowledge. Constructivism is defined as a set of beliefs about knowledge that begins with the assumption that reality exists but cannot be known as a set of truth (Tobin & Tippins, 1994). Kruckeberg (2006) indicates that if new content is not connected to students' prior experiences, it is difficult for the student to find it meaningful, which impacts their ability to assimilate the new information.

The aim of a constructivist model, consequently, is to give students experiences that make them adjust their conceptions. The students will therefore be able to "redefine, reorganize, elaborate, and change their initial concepts through self-reflection and interaction with their peers and their environment" (Bybee 1997, p. 176). Von Glasersfeld (1993) argues that constructivism is a way of knowing that recognizes the real world as a source of knowledge. We want students to learn about the external world made up of objects and events. Students can however form approximations of reality, but never a true idea of it. What we can endeavour to achieve is to build useful ideas about the world that are viable and can be used to understand and explain nature. This thought implies that reality is dependent upon the mind for its existence, hence knowledge is constructed by the mind rather than being a facsimile of reality (Von Glasersfeld, 1993).

Constructivist thinking assumes that anything constructed by the learner becomes meaningful and compels the learner to a perspective about learning through the individual systems and experience and to find a relationship between the previous and the new knowledge (Gordon and Mordechai 2009).

Within constructivism there are different notions of the nature of knowledge and the knowledge construction process. Moshman (1982) has identified three types of constructivism: exogenous constructivism, endogenous constructivism and dialectical constructivism.

In exogenous constructivism, as with the philosophy of realism, there is an external reality that is reconstructed as knowledge is formed. Thus one's mental structures develop to reflect the organization of the world. The information processing conceptualizations of cognitive psychology emphasize the representation view of constructivism, calling attention to how we construct and elaborate schemata and networks of information based on the external realities of the environments we experience.

Endogenous constructivism or cognitive constructivism (Cobb, 1994; Moshman, 1982) focuses on internal, individual constructions of knowledge. This perspective, which is derived from

Piagetian theory (Piaget 1977, 1970) emphasizes individual knowledge construction stimulated by internal cognitive conflict as learners strive to resolve mental disequilibrium. Essentially, children as well as older learners must negotiate the meaning of experiences and phenomena that are discrepant from their existing schema. Students may be said to author their own knowledge, advancing their cognitive structures by revising and creating new understandings out of existing ones. This is accomplished through individual or socially mediated discovery-oriented learning activities.

Dialectical constructivism or social constructivism (Brown, Collins, & Duguid, 1989; Rogoff,

1990), views the origin of knowledge construction as being the social intersection of people, interactions that involve sharing, comparing and debating among learners and mentors. Through a highly interactive process, the social milieu of learning is accorded center stage and learners both refine their own meanings and help others find meaning. In this way knowledge is mutually built.

This view is a direct reflection of Vygotsky's (1978) socio cultural theory of learning, which accentuates the supportive guidance of mentors as they enable the apprentice learner to achieve successively more complex skill, understanding, and ultimately independent competence.

The fundamental nature of social constructivism is collaborative social interaction in contrast to individual investigation of cognitive constructivism. Through the cognitive, give and take of social interactions, one constructs personal knowledge. In addition, the context in which learning occurs is inseparable from emergent thought. This latter view known as conceptualism in psychology becomes a central tenet of constructivism when expressed as situated cognition. Social constructivism captures the most general extant perspective on constructivism with its emphasis on the importance of social exchanges for cognitive growth and the impact of culture and historical context on learning. "While there are several interpretations of what constructivist theory means, most agree that it involves a dramatic change in the focus of teaching, putting the students' own efforts to understand at the center of the educational enterprise" (Prawat, 1992). Thus despite the differences sketched above, there is important congruence among most constructivists with regard to four central characteristics believed to influence all learning: 1) learners construct their own learning; 2) the dependence of new learning on students' existing understanding; 3) the critical role of social interaction and; 4) the necessity of authentic learning tasks for meaningful learning (Bruning, Royce, & Dennison, 1995; Pressley, Harris, & Marks, 1992).

For the learner to construct meaning, he must actively strive to make sense of new experiences and in so doing must relate it to what is already known or believed about a topic. Students develop knowledge through an active construction process, not through the passive reception of information (Brophy, 1992).

According to Brownstein (2001) learners should constantly be challenged with tasks that refer to skills and knowledge just beyond their current level of mastery. This captures their motivation and builds on previous successes to enhance learner confidence (Brownstein 2001).

In other words, learners must build their own understanding. How information is presented and how learners are supported in the process of constructing knowledge is of major significance. The pre-existing knowledge that learners bring to each learning task is emphasized too. Students' current understandings provide the immediate context for interpreting any new learning. Regardless of the nature or sophistication of a learner's existing schema, each person's existing knowledge structure will have a powerful influence on what is learned and whether and how conceptual change occurs.

2.9 Traditional and Constructivist Instructional Methodologies

According to Stofflett (1998) the traditional classroom often looks like a one-person show with a largely uninvolved learner. Traditional classes are usually dominated by direct and unilateral instruction. Traditional approach followers assume that there is a fixed body of knowledge that the student must come to know. Students are expected to blindly accept the information they are given without questioning the instructor (Stofflett, 1998). Even in activities based subjects, although activities are done in a group but do not encourage discussion or exploration of the concepts involved. This tends to overlook the critical thinking and unifying concepts essential to true science literacy and appreciation (Yore, 2001). This teacher-centered method of teaching also assumes that all students have the same level of background knowledge in the subject matter and are able to absorb the material at the same pace (Lord, 1999).

In contrast, constructivist or student-centered learning poses a question to the students, who then work together in small groups to discover one or more solutions (Yager, 1991). Students play an active role in carrying out experiments and reaching their own conclusions. Questions are posed to the class and student teams work together to discuss and reach agreement on their answers, which are then shared with the entire class. Students are able to develop their own understanding of the subject matter based on previous knowledge, and can correct any misconceptions they have. Both teaching styles can lead to successful learning but it has been shown that students in the constructivist environmental demonstrated more enthusiasm and interest in the subject matter. In fact, repeated research has found that teacher-centered lessons can be less or non-productive, and in some cases, detrimental to the students' learning process (Zoller, 2000). Many teachers are hesitant to try the constructivist model, because it requires additional planning and a relaxation of the traditional rules of the classroom (Scheurman, 1998).

Teachers often feel as though they aren't doing their job if the students are working together and actively discussing the material instead of busily taking notes (Sprague and Dede, 1999). Since any new idea is likely to be rejected unless teachers examine their own theoretical framework and develop their own justification for the change, it was suggested that additional quantitative evidence in support of constructivism might encourage more teachers to embrace this teaching style (Shymansky, 1992). Numerous studies have been completed to compare students' learning in traditional and constructivist classrooms. These studies generally based their conclusions on test or quiz scores and student comments or evaluations (Lord, 1997; Lord, 1999). The use of a quantitative analysis based on videotapes of the labs, which takes into account the actions of both students and teacher, should provide a new outlook on these teaching styles, as well as offering another means of objectively comparing the results.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter describes the research design, sample and sampling technique as well as research instruments. The chapter continued with validity and reliability of the instruments, piloting of instrument, data collection procedure, data analysis and intervention activities.

3.1 Research Design

The study was an action research which aimed to collect information regarding the use of computer assisted instruction in the teaching of some selected topics in mechanics. According to Miller (2007), action research is a natural part of teaching in which teachers are continually observing students, collecting data and changing practices to improve student learning, the classroom and school environment. Action research provides a framework that guides the energy of teachers toward a better understanding of why and how students become better learners (Miller, 2007). Action research was chosen because it improves teacher's classroom practice and enhances students' learning, and also promotes personal and professional growth of the teacher (Johnson, 1995).

In the use of computer assisted instruction in teaching, the first step was to assess the knowledge of the students about those selected topics through question and answer method and pre-test was administered. These topics had been taught to all the second year students a term before this study using traditional instruction method. The second step was the teaching of the accessible population the selected topics in mechanics through computer assisted teaching method. The students were made to take post-test after the teaching period of one week. The performance of the students at the pre-test and post-test were then compared to obtain the effectiveness of the intervention activities.

3.2 Research Population

A research population is known as a well-defined collection of individuals or objects known to have similar characteristics (Castillo, 2009). Castillo differentiates between two types of population research: the target population and the accessible population. The target population which is also known as the theoretical population refers to the group of individuals to which researchers are interested in generalizing the conclusions. Whilst the accessible population which is also known as the study population, is the population in research to which the researchers can apply their conclusions. The target population for this study was all students at Afife Senior High Technical School in the Ketu North District in the Volta Region of Ghana. However, the accessible population of the survey was constituted by second year students of Afife Senior High Technical School. The second year students of Afife Senior High Technical School with a population of about ninety-two (92) were purposively chosen for the research because they were not under pressure to write any external examination neither were they new to the selected topics in mechanics.

3.3 Sample and Sampling Technique

A sample is a finite part of a statistical population whose attributes are studied to gain information about the larger population (Webster, 1985). According to Castillo (2009) sampling techniques are the strategies applied by researchers during the sampling process. Random sampling was used to select sample size of fifty (50) students. The total sample size was made up of twenty-seven (27) boys and twenty-three (23) girls. In simple random sampling, every member of the population has an equal and independent chance of being selected for the sample. Creswell (2005) contended that the simple random sampling is the most popular and rigorous form of probability sampling. In simple random sampling the researcher selects participants for the sample so that any individual has an equal probability of being selected from the population. The intent of simple random sampling was to choose individuals that were to be representative of the population. Out of these students, only those selected were made to take pre- and post-intervention tests.

3.4 Research Instrument

Test items, observation and interview were the main assessment instruments employed to answer the research questions in the study. To ascertain students' performance in some selected topics in mechanics, Physics Achievement Test (PAT) was developed and was used in the pre-test and post-test. The Physics Achievement Test (PAT) composed of multiple choices of 20 questions on force, motion and pressure concepts (See Appendix A).

3.5 Reliability of Instrument

Reliability refers to the consistency and dependability of test results. It is often defined as the degree to which a test is free from errors of measurement (Ebel & Frisbie, 1991). According to Jack and Norman (2003), reliability refers to consistent scores or answers provided by an instrument. In reliability, one seeks to find out how consistent scores obtained are for each individual from one administration of an instrument to another and from one set of items to another. The reliability of the items was determined by stating the items in a clear and simple language with no ambiguities.

These techniques did not solve all reliability problems; hence another technique that was adapted to cross-check the reliability of the measure was the test-retest method. In this approach the test items were administered to group of students outside the research area. The same items were re-administered to the same group of students after a period of two weeks. The test-retest results were then compared and the relationship between the scores was noted.

3.6 Validity of the Instrument

As observed by Aikenhead (2005), the quality of a research instrument is determined by its validity. According to Golafshani (2003), validity describes whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure. Validity primarily aims at determining whether the instruments measure what they intend to measure. In order to ensure the validity of data collected for this study, two science teachers from Afife Senior High Technical school and my supervisor scrutinized the test items for its ambiguity and suggestions were offered for improvement. This helped to improve the validity of the instruments.

3.7 Pilot- Testing of Instruments

Pilot test, according to Pilot and Hungler (1995), is a small scale version or trial done by the investigator in preparation for the major study. The study was pilot tested with 20 students studying and learning Building construction from the same school with the students sampled to participate in the study. These students did not participate in the actual study. In this study, pilot test was conducted by the researcher to improve the validity and reliability of instrument. Items that were either too difficult or found ambiguous were rephrased. The pilot test was also done to identify and clarify any unanticipated problems and difficulties which might arise during the actual study. This helped to refine the research procedures like test administration, scoring procedures and data analysis. On the bases of the result from the pilot study, items which respondents did not understand or answer were revisited.

3.8 Data Collection Procedure

McMillan and Schumacher (1972) identified data collection procedure as approaches and techniques that the researcher uses in collecting data from the subjects. In gathering data for this study, prior permission was sought from the Headmaster of Afife Senior High Technical School.

The Physics Achievement Test (PAT) composed of multiple choices of 20 questions about Force, motion and pressure was developed by the researcher and students were given 25 minutes to answer the Physics Achievement Test (See Appendix A).

The students were taught by the researcher before pre-test by traditional instruction method and after pre-test by computer assisted instruction. At the end of teaching using computer assisted instruction, post-test had been given to students and from that data was collected to test the research questions. The pre-test and post-test were designed and self-administered to explore the effect of computer assisted instruction on the performance in some selected topics in mechanics.

3.9 Method of Data Analysis

Data analysis is the process of converting raw data collected into usable information (Statistics Canada, 1998). According to Mertler and Charles (2005), data analysis involved contextualization, where research findings were interpreted with reference to data got from the questionnaires. The study employed both qualitative and quantitative methods of data analysis. The data on test scores were put forward according to the responses of students. The pre-test and post-test scores of students were analysed statistically using t-test with equal variance on both the pre-test and the post-test scores with alpha < 0.05 level of significance, to discover if any significant difference existed between the pre-test and post-test. This was done by using Windows 8.0 and Microsoft Office Excel 2010.

3.10.1 Pre-intervention

This phase consisted of an activity which was done to ascertain the level of students' performance in some selected topics in mechanics. The first activity was the revision of some of the concepts learnt in the previous term. These concepts included Archimedes principles, principles of flotation and floating bodies, conditions of equilibrium and pressure in liquids and these are all under the topic force, motion and pressure. The lesson took place in the first week of the study with most of the learning activities being oral interactions of the researcher with the students. A traditional instruction method was used. The researcher used direct teaching and question and answer methods to teach related topics and basic concepts. Basic explanations and question and answer methods suited the traditional teaching approach where students are completely passive.

Instruction was provided by researcher through lecture and discussion methods to teach the concepts. The entire class was structured as a unit, notes were written on the chalkboard about the definition of concepts. The fundamental principle is that there is transfer of knowledge from the teacher to the students. Worksheets were developed specifically for each lesson. Written responses were required from the students which was collected and corrected. Each lessons consisted of the researcher presenting the correct way to work out problems.

3.10.2 Intervention

Force, motion and pressure concepts which were basis for the activities of the study were taught to the students by using computer assisted instruction (CAI). The topic was then treated using Physics education technology (Phet), which gave students the opportunity to observe animations, watch videos, read textual materials and interact with the teacher through questioning and discussions. Students' lack of understanding of concepts in the topic was treated during the interactive lessons with the aid of the Physics education technology (Phet).

Simulations were projected and students were asked to "Explain why a balloon filled with hydrogen gas floats in air" Students answered as "a balloon filled with hydrogen will rise and float in air. The density of air is much greater than that of hydrogen; it is about 14 times greater. The average density of the balloon containing hydrogen is less than the density of the air. The weight of air, which will be displaced by the balloon with hydrogen, is greater than that of the balloon. In accordance with Archimedes principle the balloon is acted upon by a resultant upward force equal to the difference between the weight of the balloon and the weight of air displaced. The resultant upward force provides the lifting power of the balloon.

In the explanation of how pressure at all points at the same level or height in a liquid is the same, the researcher used simulations to demonstrate by means of a tall vessel with water and two side tubes or holes on opposite sides fitted at same height or level. The speed with which water comes out is the same in all directions.

3.10.3 Post-intervention

This phase of the study involved monitoring the effects of the intervention strategies on the students' learning and evaluation of the intervention strategies. This was done by assessing and monitoring students' work outputs at the end of each week. Students' outputs were monitored by the researcher based on their responses to the questions in the weekly tests as well as during lessons. Their responses were judged whether they were related to the questions asked. The findings from this series of observations were used to modify and adjust the interventional strategies to achieve the desired learning outcomes. Results from this activity served as a basis for evaluating the performance of students and the intervention strategies implemented.

CHAPTER FOUR

ANALYSIS AND DISCUSSION OF DATA

4.0 Overview

This chapter is devoted to the analysis of results and discussion of findings gathered through data collection. The results of the study were gathered from interviews conducted on the students, as well as their progress in performance monitored through the response to test items and finally observations of students during the intervention stage to ascertain whether the computer assisted instruction used in presenting lessons could impact on students' performance. The computer assisted instruction was used as against the traditional method of teaching. The study took place at Afife Senior High Technical School in the Ketu North District of the Volta Region. The chapter presents data that covered both pre-intervention and post-intervention activities.

4.1 Pre-intervention Data Analysis

The researcher, prior to the intervention, found out that most of the students in the science class who were part of this study had little interest in science lessons and therefore did not participate well in class. They showed a minimal effort to class discussions and performance was low. Oral interactions with students brought to light some reasons for the little interest towards science.

- Students admitted that they were unable to understand some of the science concepts hence they tend to memorize formulas and concepts.
- Students were not given enough class exercises and assignments regularly as well as boring teaching.

At the end of the week a pre-intervention test was organized for the students.

Table 1 below shows the scores obtained by the students when the pre-test was administered in the pre-intervention activity, the sample size is 50.

Table 1: Scores obtained by students during pre- test

Score: 12, 15, 14, 11, 12, 11, 10, 9, 10, 11, 12, 15, 16, 14, 15, 10,
11,14,13,12,13,12,14,10,11,12,14, 13,12,15,16,12,11,12,13,14,13,12,13,14,13,12,14,15,16,15,14,16,12,11

The mean for the above table is 12.82

4.2 Intervention

During the intervention stage, students were taught force, motion and pressure concepts in science using computer assisted instruction (CAI), this method employed the use of Physics education technology (Phet), which included animations, videos, text, simulations and audio visuals. The actual implementation of the intervention began on the third week with the students. Monitoring students' progress in performance and contributions and interest during the science lesson presentation could provide information on the effect of computer assisted instruction (CAI) on the overall achievement of students in those selected topics in science. Altun, Yiğit and Alev (2007) demonstrated that computer supported material can be used for making abstract concepts concrete in teaching physics. In this study, the software with simulations adopted may be seen to be close to real life situations. With this software, students are likely to learn more effectively with better understanding of concepts. Students may develop interest in a subject when there is better understanding.

Computer-based instruction applications, because of their flexible and varied presentation capabilities, are considered as an effective alternative to traditional training methods (Varank, 2005). Varank (2005) further indicated that in many educational and training settings, interactive computer programs are used to teach young students and adults, computer literacy skills.

4.3 Post-intervention Data Analysis

This section explains the analysis made to answer the research questions for this study. Also in this part, the data generated from the students' pre- and post-intervention tests scores are analysed in line with the research questions.

The table below shows the scores obtained by the students when the post-test was administered in the post-intervention activity, the sample size is 50.

Table 2: Scores obtained by students during post- test

Score:
14,17,15,13,13,13,14,10,13,14,16,17,18,16,17,13,13,17,14,15,15,17,18,12,15,13,15,16,14 16,17,15,13,14,14,18,15,16.17,18,15,15,17,19,19,18,17,19,14,13.

The mean for the above table is 15.32

Analysis of data with respect to research question one:

Research question 1:

What is the knowledge level of students before the use of computer assisted instruction?

This research question sought to find out the students' knowledge level in the selected topics before they were exposed to computer assisted instruction. Furthermore, the data was to serve as the baseline information regarding performance.

Table 3: Students mean value of pre-intervention test

	Mean	N	Std. Deviation	Std. Error
Pre-test	12.82	50	1.804	0.255

Table 3 shows the mean of the pre- intervention test. The mean gave 12.82 while the standard deviation was 1.804. So the mean score of the test result shows the knowledge the students possess before the use of computer assisted instruction (CAI).

Analysis of data with respect to research question two:

Research question 2:

What is the knowledge level of students in some selected topics in mechanics after the use of computer assisted instruction?

This research question sought to find the effect of computer assisted instruction on performance after the use of computer assisted instruction in teaching. Descriptive statistics method was used to analyse the mean and the data.

Table 4: Students mean value of post-intervention test

	Mean	N	Std. Deviation	Std. Error
Post-test	15.32	50	2.055	0.2906

Table 4 shows the mean of the post- intervention test. The mean gave 15.32 while the standard deviation was 2.055. So the mean score of the test result shows the level of knowledge the students had acquired when the concepts were taught using computer assisted instruction (CAI)

Table 5: Students mean values of pre- and post- intervention tests

	Mean	N	Std. Deviation	Std. Error
Pre-test	12.82	50	1.804	0.255
Post-test	15.32	50	2.055	0.2906

Table 5 shows the means of the pre- and post-intervention tests. The mean of pre-intervention test gave 12.82 and that of the post-intervention test was 15.32. This shows that there was much improvement in student's performance in the post- intervention test; this implies that the use of computer assisted instruction (CAI) as an intervention had a positive impact on the performance of students in science. These findings were consistent with observation made by several researches that using computer assisted instruction (CAI) has a positive effect on students' achievement compared to traditional methods (Okoro & Etukudo, 2001; Paul & Babaworo, 2006; Egunjobi, 2002). According to Ezeliora (2002) the use of computer assisted instruction (CAI) provides the learner with different backgrounds and characteristics of learning. Using teaching software such as computer assisted instruction (CAI), concepts are presented to the students in such a well-organized manner that makes for greater clarity and easier understanding. Okoro and

Etukudo (2001) used computer assisted instruction (CAI) in teaching chemistry, Paul and Babaworo (2006) in technical education courses, Egunjobi (2002) in geography and Karper, Robinson, and Casado – Kehoe (2005) in counseling education. These researchers confirmed that computer assisted instruction (CAI) is seen to be effective in enhancing students' performance in other subjects than the conventional classroom instruction.

In taking a closer look at their standard deviation also, the result of the post- intervention test gave a higher value which confirmed that the computer assisted instruction (CAI) was good in the teaching of science concepts. Several studies have been done to determine if a relationship exists between computer assisted instructions (CAI) and learning and long term retention. One such study involved 11 and 12 year old students using an interactive algebra program (Thomas & Tall, 1998). Thomas and Tall (1998) found in their study that after one year of completing the study, both experimental and control groups were retested using the original posttest intervention. Students who used computer assisted instruction (CAI) scored significantly higher than students in the control group.

Table 6: Comparing student's scores of pre- and post - intervention test

	Mean	Std. deviation	Std. mean error	t	df.	Significant (2-tailed)
Pre-test-post-test	2.50	0.251	.3262	16.76	49	.000

*P<0.05 significance (α=0.05)

Table 6 shows a comparison of students' overall mean scores for both pre- and post - intervention tests. The mean difference as seen in the table was 2.50 indicating that students scored higher marks in the post- intervention test than the pre- intervention test. The difference between the mean scores was significant at p-value of 0.00. In this study, the significant difference was set at alpha value of **(α=0.05).** This means that there was a significant difference between the two test scores. This attests that the use of computer assisted instruction (CAI) method in the study of science improved the performance of the students in Afife Senior High Technical School in the Ketu North district of the Volta Region.

Analysis of data with respect to research question three:

Research question 3:

What is the interest of students in some selected topics in mechanics after the use of computer assisted instruction?

Quite often than not, students' interest towards the study of science is not encouraging. So this research question sought to check the interest of students toward the study of science before and after the use of computer assisted instruction method was used.

Table 7: Comparing the mean values of students' pre- and post- responses on interest towards science teaching and learning.

	Pre/Post	N	Mean	Sig.	Std. deviation
Students' Interest toward Science Teaching and Learning	Pre	50	2.19		0.73
	Post	50	3.55	.000	

*P<0.05 Significance (α =0.05)

Table 7, the mean values of the students' in the pre and post responses on their interest towards science teaching and learning were compared. The mean scores of the students' Pre-intervention responses were relatively lower than their mean scores for post intervention responses for the same category of items. In order to determine whether the differences in the pre- and post-intervention responses were statistically significant, a paired sample t-Test analysis was used. The results confirmed that the differences in most of the pre- and - post - intervention responses were statistically significant. Thus, the students' interest towards the teaching and learning of science had improved upon the exposure of computer assisted instruction (CAI) in the teaching and learning of science. This result relates to the view of (Jackson, 1988), a study that was conducted to find out the effect of the computer on attitude, motivation or learning, and the possible advantages of computer assisted test programs. The assessment of the experimental group was done using computers, whereas that of the control group was done through a written test. The statistical evaluations displayed a higher achievement rate for the experimental group that received a computer assisted test.

Computer assisted instructional materials are more effective in developing favorable attitude, and in capturing interest towards learning physics as observed by (Azar & Şengüleç, 2011).

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION, RECOMMMENDATIONS AND SUGGESTIONS FOR FURTHER STUDIES

5.0 Overview

This chapter provides the summary of the research study. It includes the findings of the study, conclusion and recommendations. It further outlines some suggestions for further studies.

5.1 Summary of the Study

The study investigated the effect of computer assisted instruction on the performance in some selected topics in mechanics. Action research design was therefore used to find facts and to describe conditions in Afife Senior High Technical School. The total population for the study was fifty (50) students. The total sample size was made up of twenty-seven (27) boys and twenty-three (23) girls of Afife Senior High Technical School.

Data was gathered through Physics Achievement Test (PAT) composed of multiple choices of 20 questions about force, motion and pressure. The students were taught by the researcher before pre- intervention test by traditional instruction method and after pre-intervention test by computer assisted instruction (CAI). At the end of teaching using computer assisted instruction, post-intervention test had been given to students and from that data was collected to answer the research questions. The study employed both qualitative and quantitative methods of data analysis. T-test statistical analysis techniques were used with Windows 8.0 and Microsoft Office Excel 2010 to analysis the data. The findings obtained in this study revealed the major activities and issues concerning the effect of computer assisted instruction on the performance in some selected topics in mechanics.

5.2 Summary of the key findings of the Study

Based on the results and the discussions presented in relation to the research questions, the study revealed that the second year students of Afife Senior High Technical School performed poorly in the pre- intervention test on force, motion and pressure concepts.

The 2-tailed t-test analysis of the students' pre- and post- test scores showed that students' knowledge in force, motion and pressure concepts has improved significantly as a result of the use of computer assisted instruction. Therefore, computer assisted instruction is an effective teaching strategy on the performance in some selected topics in mechanics (See Appendix C). By using this teaching strategy, better acquisition of scientific concepts could be observed.

It was also revealed that with the use of computer assisted instruction, knowledge is constructed and this causes students to have more interest towards science as a school subject.

The findings of this study had further established the fact that acceptable methods of instruction are capable of improving students' performance towards science.

5.3 Conclusion

The findings of this study indicated that the second year students of Afife Senior High Technical School performed poorly in the pre- intervention test on force, motion and pressure concepts.

In addition, the analysis of the data based on the pre- and post-tests revealed that students experience a great achievement after receiving instructional intervention using computer assisted instruction (CAI). The paired 2-tailed t-test calculated on the pre-and post-test scores was significantly different. This implied that the use of computer assisted instruction was very useful. Students were found to have scored significantly higher marks by teaching using computer assisted instruction probably because of the interplay of a higher students' activity during the lessons and social interaction which are significant features in the structure of the method. Therefore, the major findings of this study indicated that an appropriate method for teaching and learning science could be the computer assisted instruction. Computer assisted instruction would reduce the frustration students will experience with the other methods when dealing with very novel concepts and consequently lead to poor performance

Finally, the research findings revealed that students developed more interest towards science after the use of computer assisted instruction (CAI).

5.4 Recommendations

Based on the results of this study, it is recommended that the use of computer assisted instruction, a type of instructional strategy that is capable of transforming students from passive receptacles of information into active learners, should be used to teach science. Also, teachers should be exposed to new and emerging techniques that are relevant for the class room and can motivate students, and thereby increase their performance.

Relevant educational authorities such as the Ghana Education Service should also consider providing teachers with adequate professional development, time and incentives to encourage them to integrate inquiry and technology appropriately into their instruction.

Teachers and educationist should embrace computer assisted instruction in their various institutions if we want to increase student's interest in science in the senior high schools. It would also be essential to organize seminars and workshops for practicing teachers so that the importance of the computer assisted instruction for science teaching and learning could be extended.

Finally, it is recommended that students should be fully engaged by the use of computer assisted instruction in order to develop student's interest in science.

5.5 Suggestions for Further Research

The following suggestions are made for further researches:

1) Further research studies can be carried out to investigate the effectiveness of computer assisted instruction approach in understanding science concepts in different schools. So, more accurate results can be obtained and a generalization for Ghana can be provided.
2) A study can be conducted for different levels and different science topics to investigate the effectiveness of the computer assisted instruction. This study can be conducted with larger sample size in order to obtain more accurate results.

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APPENDICES

APPENDIX A

The Physics Achievement Test

This assessment consists of 20 pairs of questions which examine your knowledge on force, motion and pressure. Each question is followed by four options lettered A to D. Find the correct option for each question.

1. When a vehicle stops suddenly, passengers jerk forward. This is due to the

A. wind surrounding the vehicle.

B. force acting on the vehicle.

C. reaction of the passengers.

D. inability of the bodies of the passengers to stop moving.

2. A body is projected vertically upwards from the ground with an initial velocity of $10ms^{-1}$. Calculate the maximum height reached. ($g = 10m^{-2}$)

A. 0.5 m

B. 5.0cm

C. 10.0m

D. 15.0m

3. A stone tied to the end of a rope and whirled round performs

A. Oscillatory motion

B. circular motion

C. rectilinear motion

D. vibratory motion

4. The force which opposes the relative sliding motion of two surfaces in contact is

A. electrostatic force

B. frictional force

C. gravitational force

D. magnetic force

5. Fast moving vehicles overturn when negotiating curves because of

A. adhesive force

B. centripetal force

C. frictional force

D. tensional force

6. The mass of an object is 24.0kg on earth. What will be its mass on the moon, if the acceleration due to gravity on the moon is 1/6 that on the earth?

A. 114.0kg

B. 96.0kg

C. 24.0kg

D. 4.0kg

7. The pressure in any part of a fluid depends on the

A. Weight and volume of the fluid

B. Height and density of the fluid

C. Mass and volume of the fluid

D. Surface area and depth of the fluid

8. A floating balloon may eventually burst because

A. its density has increased

B. the buoyant force on it increases

C. The magnetic force in it due to the surrounding increases

D. its internal pressure becomes greater than that of the surroundings.

9. Which of the following instruments does not depend on pressure for its operation?

A. Siphon

B. Force pump

C. Thermometer

D. Barometer

10. Objects are weightless in space, because

A. the force of the gravity exactly balances the weight of the objects.

B. there is no air

C. there is negligible force of gravity

D. The up thrust on the objects is equal to the weight of the object.

11. The centre of gravity of a body is the point

A. Where its original weight acts

B. where the body can be stable

C. where the total mass of the body acts

D. Which divides the body into two equal parts.

12. A reversible reaction attains equilibrium when

A. the forward reaction is faster

B. both the forward and backward reactions are at the same rate.

C. the backward reaction is faster

D. a catalyst is used

13. The pressure at any point in a liquid

A. is not affected by acceleration due to gravity

B. depends on its depth below the surface of the liquid.

C. is proportional to the cross-sectional area of the liquid at that point.

D. depends on the shape of the container.

14. A body moves with a velocity of 30.0m/s. This speed is increased to 40.0m/s in 4.0s. Calculate the average acceleration of the body.

A. 17.5ms-2

B. 8.8ms-2

C. 4.4 ms-2

D. 2.5ms-2

15. Which of the following components is not found in the bicycle pump?

A. Washer

B. Plunger

C. Barrel

D. Pivot

16. A body pushes a stationary car. The car moves reluctantly. This is partly because the car has

A. a momentum

B. a moments

C. an inertia

D. an impulse

17. Which of the following quantities can be classified as force?

A. Effort

B. Mass

C. Moment

D. Momentum

18. Distance travelled in a specified direction is known as

A. acceleration

B. displacement

C. speed

D. velocity

19. Reduction of friction in car engine is achieved by

A. lubricating

B. loosing

C. overhauling

D. spraying

20. The unit of velocity is

A. ms

B. m/s

C. m/s^2

D. m^2/s

APPENDIX B

MARKING SCHEME FOR PRE AND POST-TEST

1 D

2 B

3 B

4 B

5 B

6 C

7 B

8 D

9 C

10 C

11 A

12 B

13 B

14 D

15 D

16 C

17 A

18 B

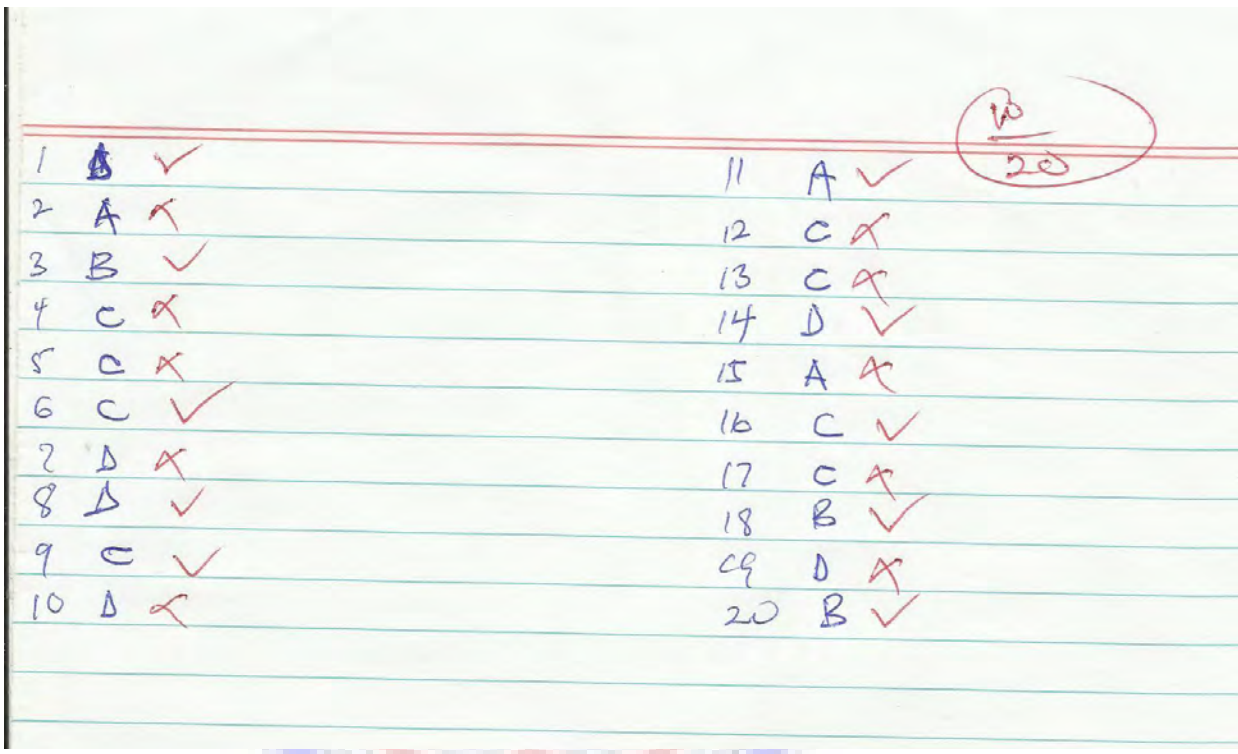
19 A

20 B

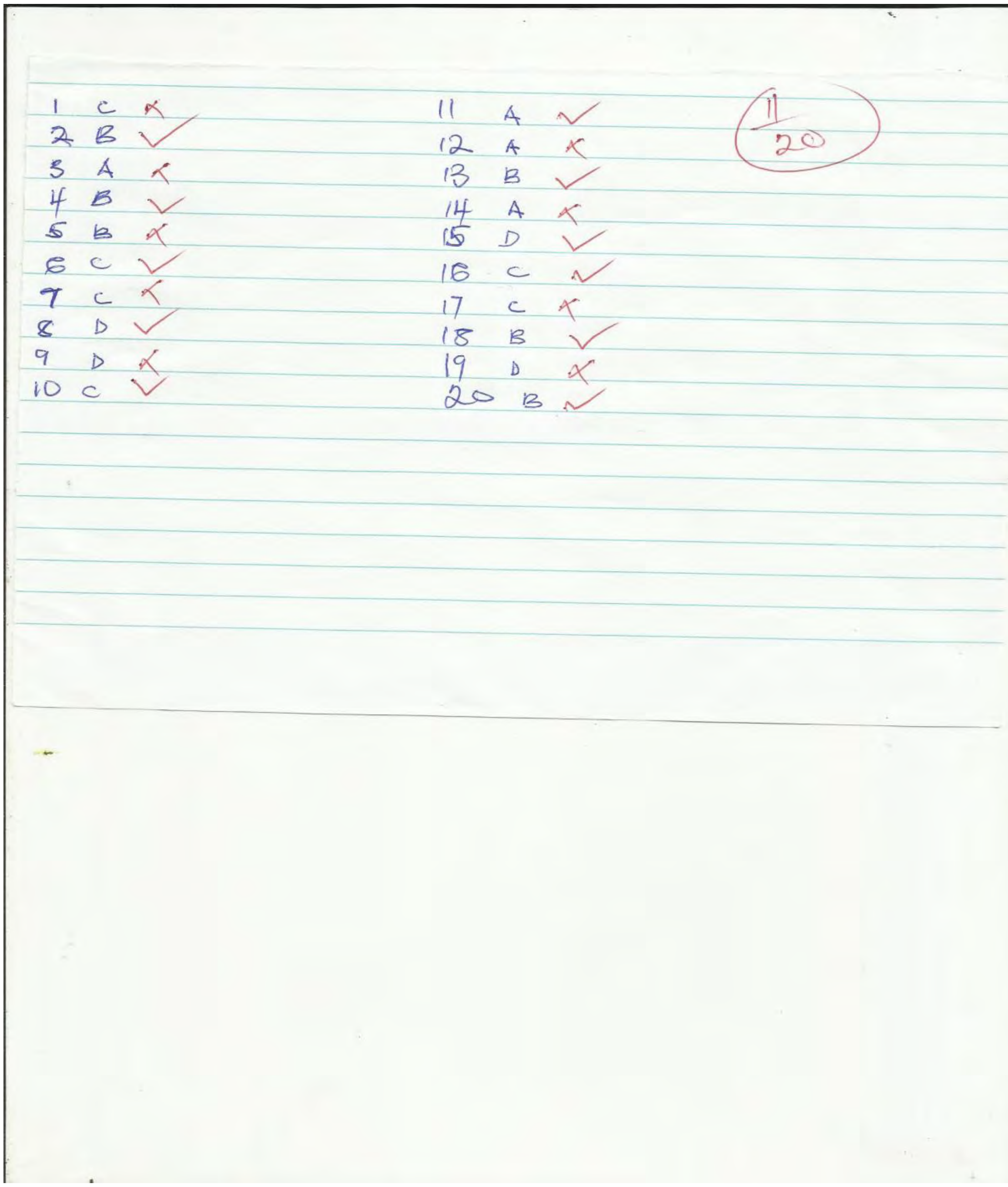
APPENDIX C

SAMPLE OF STUDENTS'S RESPONSES TO PRE-TEST ITEMS

Sample 1



Sample 2



1	C	✗	11	A	✓
2	B	✓	12	A	✗
3	A	✗	13	B	✓
4	B	✓	14	A	✗
5	B	✗	15	D	✓
6	C	✓	16	C	✓
7	C	✗	17	C	✗
8	D	✓	18	B	✓
9	D	✗	19	D	✗
10	C	✓	20	B	✓

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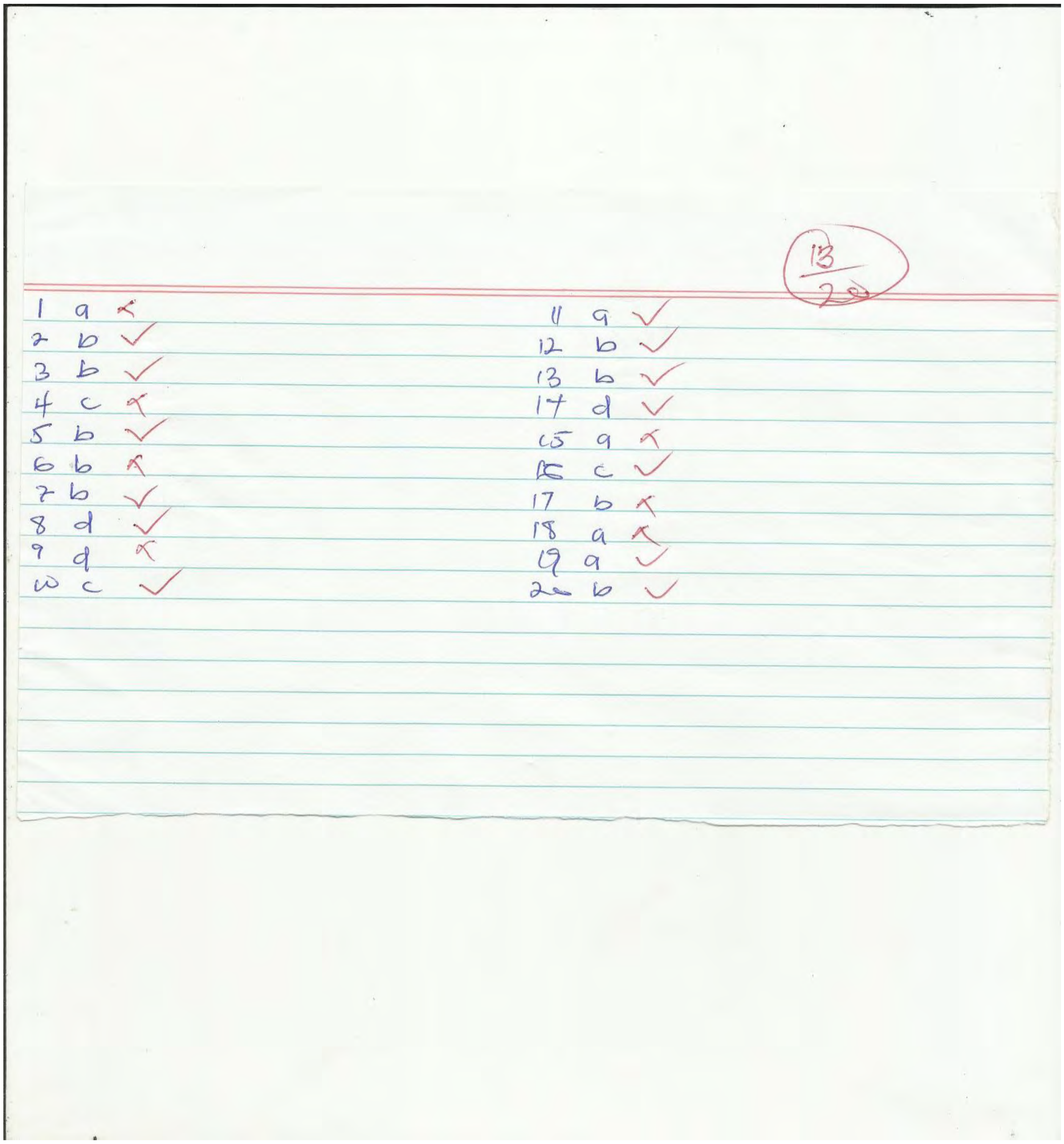
Sample 3



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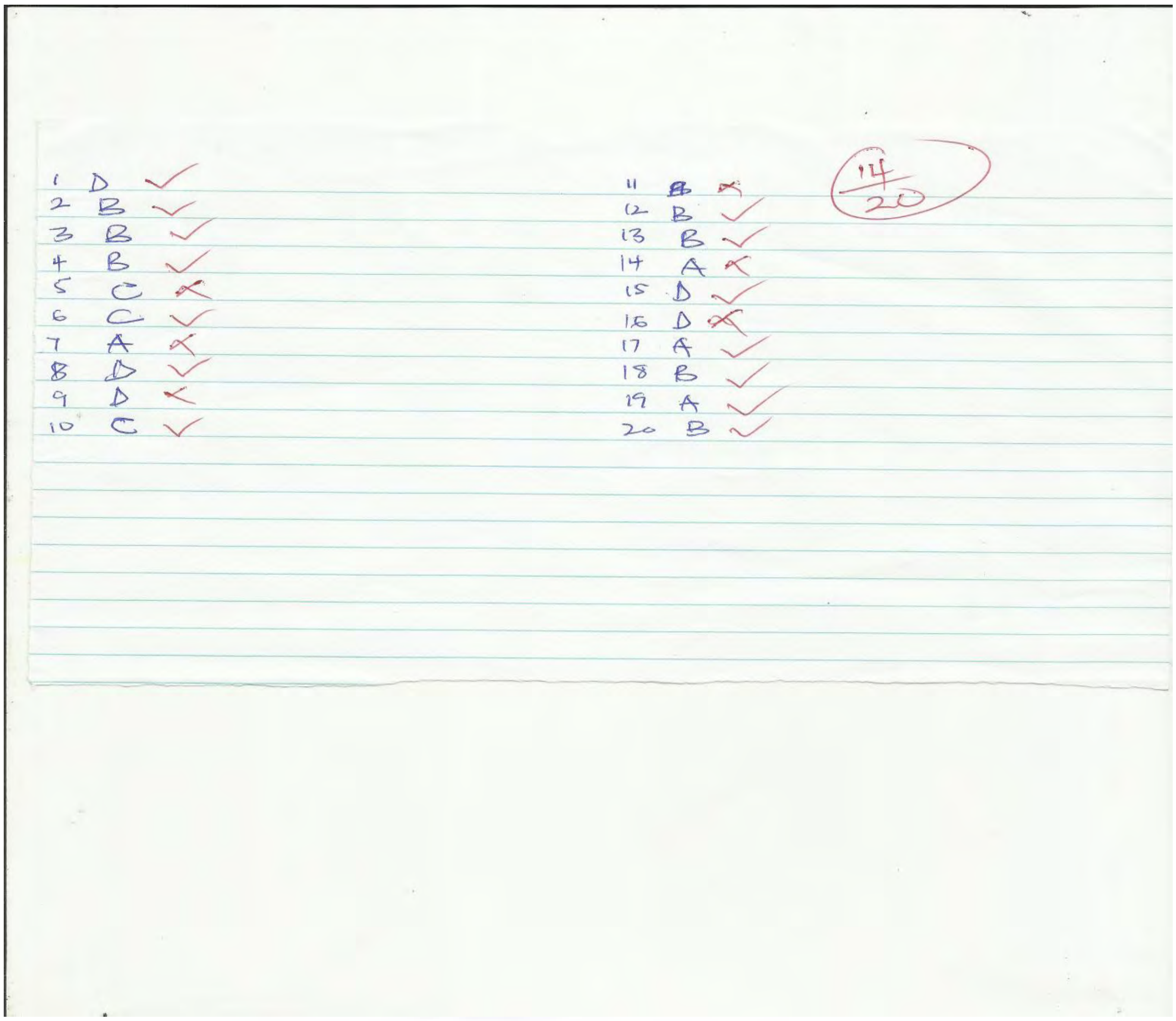
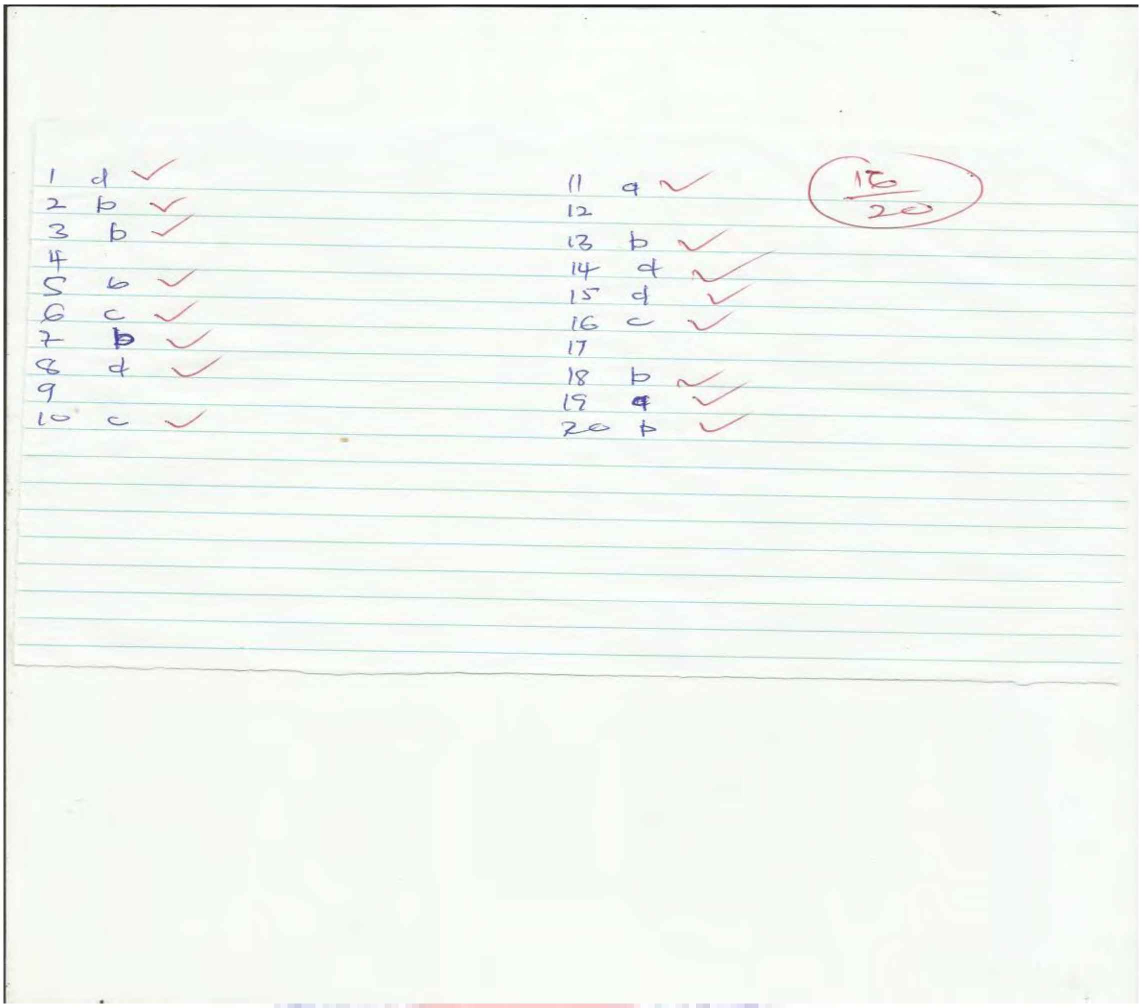
1	a	✗	11	a	✓
2	b	✓	12	b	✓
3	b	✓	13	b	✓
4	c	✗	14	d	✓
5	b	✓	15	a	✗
6	b	✗	16	c	✓
7	b	✓	17	b	✗
8	d	✓	18	a	✗
9	d	✗	19	a	✓
10	c	✓	20	b	✓

SAMPLE OF STUDENTS' RESPONSES TO POST –TEST ITEMS

Sample 1



Sample 2



1	d ✓	11	a ✓
2	b ✓	12	
3	b ✓	13	b ✓
4		14	d ✓
5	b ✓	15	d ✓
6	c ✓	16	c ✓
7	b ✓	17	
8	d ✓	18	b ✓
9		19	a ✓
10	c ✓	20	b ✓

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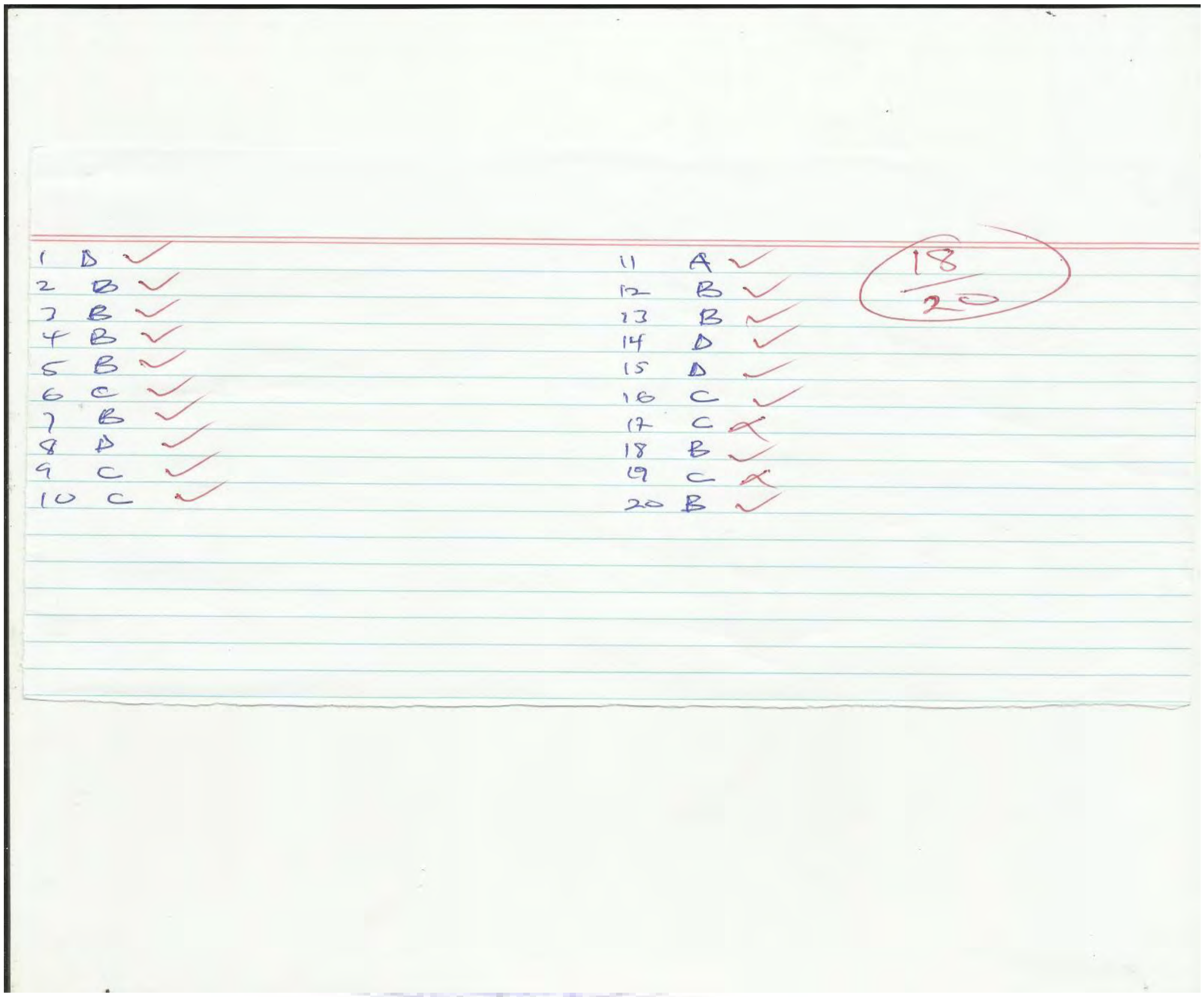
Sample 3



1 D
2 D
3 B
4 B
5 B
6 C
7 B
8 A
9 C
10 C

11 A
12 B
13 B
14 D
15 D
16 C
17 C
18 B
19 C
20 B

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