UNIVERSITY OF EDUCATION, WINNEBA

THE EFFECT OF COMPUTER BASED INSTRUCTION ON JUNIOR HIGH SCHOOL PUPILS' MISCONCEPTION ON DIFFUSION

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DECLARATION

CANDIDATE'S DECLARATION

I, Julius Odoi declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's signature:……………………..Date:…………………….

SUPERVISOR'S DECLARATION

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

Name: Dr. Ernest Ngman-Wara

Supervisor's signature:………………………………………….

Date:…………………..

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DEDICATION

This dissertation is dedicated to my father: Steve Odoi. To my brothers and cousins, the bar has been raised but I know you can climb higher than this.

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ABSTRACT

This study investigated the effect of Computer Based Instruction (CBI) on Junior High School (JHS) pupils' misconceptions on diffusion in Nkawkaw Municipality in the Eastern Region. A JHS 3 class consisting of 23 pupils was selected for the study. A quasi-experimental design was used. Pretest was used to identify the pupils' misconceptions about diffusion. The pupils had misconceptions although, based on their academic scheme of work, conventional teaching approach had previously been used to them teach diffusion. After the treatment, a post test was conducted and the results showed that the pupils performed better since the misconceptions were removed .The study was guided by a null hypothesis and based on this; Paired sample T. test was used to analyze a statistical equivalence of the pupils' pretest and posttests scores. The results indicated that CBI has effect on the JHS pupils' misconceptions on diffusion.The main conclusion reached was that; Junior High School pupils hold misconceptions on diffusion and CBI is effective on dispelling such misconceptions. And so, by using CBI with a content which addresses the misconceptions, the pupils will have the opportunity to acquire an understanding which will help them to remove the inherent misconceptions. It was recommended that: here is the need to use CBI in the teaching of science concepts throughout the country so that misconceptions can be prevented; however, if misconceptions are identified among pupils, CBI should be used to remedy them. Also, science teachers and teachers of other subject areas should be trained in the development of CBI materials so that they can adapt existing materials to teach science concepts and finally, pupils should be given more time to learn Information and Communication Technology (ICT) so that the CBI can be used for them easily.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter contains the background to the study, statement of the problem, purpose of the study, research questions, null hypothesis, significance of the study, delimitation, limitation, and organization of the study.

1.1 Background to the Study

According to Cotton (1991), Computer-Based Instruction (CBI) can be defined as learning activities in which computers generate data to illustrate relationships in models of social or physical reality, execute programmes or provide general enrichment in relatively unstructured exercises designed to stimulate and motivate learners. As computer technology evolved, so did computer-based instruction. Today, the Computer-Based Instruction model is used by myriad of learning programs throughout the world. Any instructional program that includes the use of a computer-CD-ROMs, DVDs, etc. is based on this concept, which can also be implemented in conjunction with traditional teaching methods to enhance the overall educational experience (Kulik & Kulik 1991). Computers play an important role in contemporary teaching and learning of science concepts as noted by Chang (2000). Imhanlahimi and Imhanlahimi (2008) indicate that a lot of studies in education in various countries of the world have revealed the importance of computer in science education. Therefore, the role of computers in science instruction cannot be overemphasized.

According to Olson and Wisher (2002), CBI can be a great instructional resource to teachers and students, if implemented correctly, and that CBI can reduce the cost of instruction by a third. It can either reduce the time of instruction by a third or increase the quality of instruction by a third. This successful implementation of CBI is called "The Rule of Thirds". This depends, however, on how well the CBI tutorials and learning aids are designed. If it takes a lot of time and effort to develop and maintain the tutorials, it might not be worth the benefits.

Ghana, like most developing countries, not wanting to be left behind in the use of technological innovations, has acknowledged the importance of Information and Communication Technology (ICT) in its development agenda. The Government of Ghana has therefore placed strong emphasis on the role of ICT in contributing to the country's economy and education. The country seeks to promote an improved educational system within which ICT is widely deployed to facilitate the delivery of educational services at all levels of the educational system (Republic of Ghana, 2003). This expectation is in line with the emergence and widespread use of technology as noted by Karper, Robinson and Cassado-Kehoe (2005). They observed that a different atmosphere has been created in the classroom and that educators are required to incorporate new methods of teaching in the classroom in order to properly challenge and stimulate students. Ghana is therefore envisaging an era in which teachers will make use of technology such as projectors, computers and other equipment while students on the other hand are expected to acquire basic ICT literacy, develop interest and use ICT for studying other subjects (Curriculum Research Development Division (CRDD, 2007).

Application of ICT in various ways is particularly pertinent in science education. One major technological device affecting the classroom in general and science classroom in particular is the computer (Owusu, 2009). According to Shuttleworth (2008), many learners, even science teachers, do not fully understand the nature of science, and incorrectly portray the aims of research; creating misconceptions in science which a critical issue. Studies from Kropf (2008) depicts that computer-based instruction can be used in the classrooms in so many ways with it the capacity to address many learners' problems and following its relevant features of visual simulations and instructional games, addressing learners' misconceptions cannot be excluded. Research by Demirci (2001) depicted that; solutions to students' misconceptions in science can be approached with a well designed CBI following its inherent simulations of visual elements, videos and animations. Based on studies from Demirci (2005), in a situation where there is the existence of science misconceptions, a well computerized instructional teaching method can be used for remedying. A research on a comparative efficiency of CBI and Conventional Teaching Method (CTM) in critical science issues by Ayariga, (2010) divulged that at least CBI should be used to supplement CTM in situations where ICT facilities to learners ratio proves elements of inadequacy.

1.2 Statement of the Problem

Since the basic concepts in science education form the basis for advanced science topics, they should be taught correctly and meaningfully in primary and secondary school for an effective science education (Kele & Kefeli, 2009). Schmidt and Hans-Jurgen (1997) noted that if science concepts are not correctly taught, they result in misconceptions.

Science misconception is a critical science issue that needs the intervention of a planned instructional programme (Demirci, 2001). Recent sources have shown that even science teachers have misconceptions about science (Lawrenz, 1986). It appears that apart from the attribution that it can get from interaction with the environment, it can have its root from unplanned teaching methods.

According to Berthelsen (1999), if students harbour science misconceptions without a remedial by planned teaching methods, they perform poor in examinations following elements of misconceptions which portray in their minds and become evident in their answers. Studies from Demirci (2005) divulged that these misconceptions, if not intervened by a structured instructional programme through computer software consisting of hand-on classroom experience and visual simulations, can generate into misbeliefs and stay in their minds even until adulthood. Papert (1993) stated that computers offer progressive tools that can bring and shape qualitative changes in education for educators. The computer's capacity which to interact with students and to react to their individual needs has the potential to provide a student-centered context that can assist students in learning (Demirci, 2005).

Odom, Arthur, Barrow and Lloyd (1993) believed that learners hold misconceptions in diffusion. Therefore, there is the need to find out if JHS pupils in the study area have misconceptions in diffusion. Secondly, studies from Kahraman and Demir (2011) have shown that misconceptions arise due to ineffective and unplanned teaching methods. Hence, there appears another need to find out if CBI can be effective in removing the misconceptions.

1.3 Purpose of the study

The purpose of this study was to determine the effect of computer based instruction on the Junior High School (JHS) pupils' misconceptions on diffusion.

1.4 Objective of the study

The objectives of the study were to:

1. determine JHS pupils' misconceptions about diffusion.
2. investigate the effect of CBI on the pupils' misconceptions on diffusion.

1.5 Research Questions

The questions the researcher sought to answer were:

1. What misconceptions do the JHS pupils of Nkawkaw municipality pupils hold about diffusion?
2. What effect does CBI have on the JHS pupils' misconceptions?

1.6 Null Hypothesis

To determine the effect of CBI on the JHS pupils' misconceptions on diffusion, the following null hypothesis (Ho) guided the study:

CBI has no significant effect on JHS pupils' misconceptions on diffusion.

1.7 Significance of the study

There has not been any research into the problem within the chosen District; this study was the first of its kind, and would therefore bring to light the effect of CBI on the JHS pupils' misconceptions on diffusion in the study area. Its findings would serve as a baseline for instructors to make critical decisions on the suitable teaching approach to use when faced with students with inherent misconceptions on diffusion or similar situations.

It would provide school administrators and policy makers a report that will be a very useful document. This means that, issues raised in the study could stimulate policy makers to formulate and implement policies concerning the use of CBI among students with inherent misconceptions on diffusion or similar situations. Finally, it is also important to note that, the findings of this research, would serve as a valuable document to all who would undertake further research work on the problem.

1.8 Delimitation of the study

Lack of adequate computer facilities of schools in the District made it impossible for all the schools to participate in the study. The nature of the study also limited the number of schools in the town to one. Due to time constraints, the researcher could not look at the pupils' attitudes towards CBI and the difficulties they might have with its use since this would have added another dimension to the study.

1.9 Limitation of the study

One major limitation was that the students outnumbered the computers available, compelling some students to pair. This sometimes hindered concentration. Another limitation was power outages, which disrupted the class from time to time. Some computers also had problem in running the software. All these could affect the accuracy of the findings of the study. However, efforts were made to minimize the effects of the above sources of limitation by responding quickly to any unforeseen problems that arose.

1.10 Organisation of the Study

The study is divided into five chapters. Chapter one presents the background of the study, statement of the problem, purpose of the study, research questions, research hypothesis, and significance of the study; other issues included in this chapter are limitation and delimitation. Chapter two reviews the literature relevant to the study. The third chapter discusses the research design, instrument/treatment, data collection procedure, data analysis plan and validity and reliability of the study. The fourth chapter presents results and discussions of the study. The fifth and last chapter, summarizes the study, draws conclusion and makes recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter contains literatures on science misconceptions, strategies to overcome the misconceptions, diffusion, misconceptions in diffusion, CBI and its origin, Effect of CBI on learners' misconceptions and cognition, CBI design and categories of CBI software

2.1 Science Misconceptions

Science misconceptions are common misbeliefs, where a semi-truth or falsehood is perpetuated as scientific fact (Horton, 2004). Misconception in science can hinder people in learning science and this situation does not only occur in ordinary people but it also affects people who claim to have mastered the science education such as teachers, pre service teachers and science student teachers (Schmidt & Hans-Jurgen, 1997). Every student brings to science class his/her conceptions of the world. Because of students' wide variety of experiences, each concept will hold a somewhat different meaning for each student. The general meaning of some conceptions will be shared, while others will be unique. Many of scientific misconceptions are associated with intuitive ideas or preconceptions acquired prior to school (Driver, 1987). Wandersee (1998) noted that many of the misconceptions students hold are the same as conceptions held by pre-Newtonian scientists, and younger students are more likely to hold out-dated scientific conceptions. According to him, some of the science misconceptions that learners harbour include: Photosynthesis is the opposite of respiration, the sunlight makes plants healthier, more powerful and more beautiful in colour, an object at rest has no energy, if an object is at rest, no forces are acting on it, the sunlight is the food of plants, heat is a substance, carbon dioxide is harmful for plants, seasons are caused by the earth's distance from the sun, rain comes from holes in clouds, in chemical reactions, the cations are males and the anions are females, God and angels cause thunder and lightning, oxygen is converted into carbon dioxide in photosynthesis and batteries have electricity inside them.

There are many reasons for misconceptions, many arising from bad science, but some from an oversimplification of the truth and others from urban myths that everybody thinks that they know. Many people, even science teachers, do not fully understand the nature of science, and incorrectly portray the aims of research, and what science can actually achieve. The main reason for this is that the philosophy of science is woefully neglected. Most scientific education curricula, and many scientists learn how to do experiments, but with little understanding of why, and the basic underlying processes defining the very nature of science (Shuttleworth, 2008).

Misconceptions research has compiled large volumes of research during the past fifty years. Misconceptions have been detected from preschool through college. Studies have shown that even science teachers have misconceptions about science (Lawrenz, 1986). One particularly alarming interview session found deep rooted scientific misconceptions held by Harvard graduates and professors (Private Universe, 1988). One of the most important results of research on science misconceptions has been a better understanding of difficulties in science learning and an awareness of the need for significant changes in the teaching/learning process (Gil-Perez & Carrascosa, 1987).

Another issue arises from the teacher's efforts to make scientific concepts and principles simpler and easier to understand. This often involves providing a fair and appropriate approximation of reality that is sufficient for an appropriate level of understanding for the age and/or developmental level. As students progress through their education, new layers of meaning are added to a concept. Each experience with a concept adds new meaning. A novice learner cannot be expected to appreciate all the various nuances of a concept that an advanced learner or an expert might have. What might be appropriate understanding of a concept at one level would be inappropriate at other (Odom et al., 1993).

Chiapetta and Koballa (2006) stated that misconceptions have their origins through diverse sets of personal experiences including direct observations and perceptions, peers culture and language. For example, students from different backgrounds and belief systems will interact with instruction on disease and medicine in different ways. Also, textbooks and teachers can influence student's misconceptions. For this reason, student's misconceptions have become a focus of teaching and learning. The major task of science teachers is to change the students' misconceptions which are incoherent to scientific view. The science student teachers should have a good knowledge in science. However, if they still have misconceptions in basic knowledge, then how do they detect the misconceptions that are within their students? If they realize their responsibility, they will use all their strength to solve these problems. This is because they can improve their teaching and learning process by overcoming those misconceptions (Hasniza & Yusof, 2005).

2.2 Students' Misconceptions on Diffusion

Arnaudin and Mintzes (1985) stated that diffusion and osmosis are the keys to understanding many important life processes. An understanding of osmosis and diffusion concepts is a key to understanding water intake by plants, water balance in Land and aquatic creatures, turgid pressure in plants, and transport in living organisms (Odom et al., 1993).

A report by Lloyd, et al., (1993) showed that students hold the following misconceptions on diffusion:

i. Particles generally move from high to low concentration because particles tend to move until the two areas are isotonic and then the particles stop moving.

They believed that these students might have memorized the prefix "iso" which means "the same" and interpreted it to mean that particles would continue to move until they have the same concentration throughout. It could be possible that these students had a partial understanding of diffusion, because an end result of the process of diffusion is a uniform distribution of particles (or, the particles are "the same" throughout).It could also be possible that these students might have used the term "isotonic" because they had an understanding of the underlying process (e.g. particles move until uniform distribution), but had a misunderstanding of the terminology.

ii. When particles stop moving, it is equivalent to "no net movement",

They believed that the students hold this misconception because they have partial understanding of kinetic theory of matter.

A research by Demirci (2005) showed that students hold the following misconceptions on diffusion:

i. Diffusion only occurs in gas molecules.
ii. Diffusion occurs with or without a concentration gradient
iii. Diffusion rate decreases as temperature increases.
iv. Increased concentration decreases the rate of diffusion.

Studies from Wandersee (1986) unveiled that students believe that diffusion is the opposite of osmosis; according to the students, since osmosis involves movement from lower concentration to higher concentration and diffusion involves movement from higher concentration to lower concentration, the relationship between them is that diffusion is the opposite of osmosis.

2.3 Strategies to Overcome the Misconceptions

Many techniques can be implemented to investigate the misconceptions among science student teachers such as using interview, mind maps, model or diagnostic tests. By using one or two of these techniques, it will help teacher educators in monitoring the misconceptions among science student teachers (Nor-Hasniza, Surif & Arshad, 2007). According to Opper (1977), interview is one of the earliest techniques used to investigate the misconceptions. There are three types of interview; interview about instances, interview about events and lastly prediction interviews. The role of these interviews is to know the science student teachers' understanding about certain concepts in their own words.

Mind mapping is an illustration about the relationship among concepts that are being mapped. Edmonson (2000) stressed that this technique is useful in describing science student teachers' conceptions. It can also help teacher educators to investigate cognitive structure of science student teachers especially in their previous knowledge, experience and misconceptions. This technique could also detect misconceptions of science student teachers through visual images. But still the teacher educator has to teach their science student teachers how to mind map.

Some of the researchers believe that by using a certain model, it can help the teacher educator in solving misconceptions. Through the research done by Johari and Yusof (2004), it was found that by using Generative-Metacognive Model, the misconceptions of the science student teachers could be reduced. They emphasized on the three level of thinking; microscopic, macroscopic and symbolic. The science student teachers must master these levels of thinking when learning about science concepts and this technique will effectively overcome their misconceptions.

There are a lot of other techniques which could be implemented by the teacher educator to investigate the misconceptions that occur among the science student teachers. One of the most popular techniques that should be incorporated to science student teachers is practicing reflection. Practicing Reflection is a key for a science student teacher in improving their content knowledge and teaching and learning process. Reflection, according to Dewey (1933), is an active, persistent and a careful consideration of any belief or supposed form of knowledge in the light of ground that supports it. Based on the definition, it shows that an individual who practice reflection will always feel skeptic about his/her content knowledge. He will always be willing to search for the opinions of others about his knowledge, and try hard to improve his knowledge through reading all sorts of books, journals, articles relating to his field. He will dare to sacrifice leisure time to enhance his content knowledge especially in science concept. If the science student teacher could practice reflection, he will have these three attitudes toward his content knowledge. First is openness. Second is responsibility and the third is wholeheartedness. Openness is the characteristic where the individual must accept his weaknesses of content knowledge and ready to receive other people’s opinion especially his teacher educator advice in order to improve his content knowledge and also to throw out all the misconceptions rooted in him. Other than that, the science student teachers must take responsibility to change all his misconception toward science education. If they realize their responsibility, they will use all their strengthness to solve these problems.

Lastly, the science student teachers should wholeheartedly try to be aware and overcome their misconceptions. This is because they can improve their teaching and learning process by overcoming those misconceptions. Research done by Nor Hasniza and Yusof (2005) found out that reflection can serve as a process of solving the problems, improving the understanding and changing the experience into effective learning process. These processes certainly will help the science student teachers in mastering their content knowledge and tackling the misconceptions that they had. The National Science Teacher Association (2003) has also advocated the essential things need to be prepared by the science student teacher is mastering the content knowledge deeply. Only with this technique, it will improve them to be a better science teacher.

Kahraman and Demir (2011) found that misconceptions among learners can be determined using diagnostic test. Treagust (2014) indicated that diagnostic tests have found to have a strong ability to unveil learners' misconceptions. According to Demirci (2005), the use of diagnostic test or interviews can rely on validated propositional statements on the concept about which the misconceptions are held. These statements can be changed into question items and if the learners' answers are incoherent to the validated statements then misconceptions are said to have been diagnosed. Based on his report, responses from the learners which do not conform to the validated statements will depict the misconceptions and then the appropriate remedial can be used to dispel them.

2.4 Computer Based Instruction and its Origin

Computer Based Instruction (CBI) is a teaching approach that integrates computer software programme with other teaching materials in the classroom. Other similar terms of CBI include: computer-based training, computer-assisted instruction and computer-assisted learning. There are many ways CBI can be used in the classrooms or as standalone learning tools. Teachers use CBI for drills and practices, tutorials, simulations, and instructional games Computer-based instruction, also commonly referred to as Computer Assisted Instruction, was introduced during the 1950s. The pioneers of the movement were a team of researchers at IBM, including G. Pask and M. Moore. However, it wasn't until the 1960s that the CBI theory began to take shape (Kropf, 2008). CBI started in the 1950s and 1960s, mainly in the USA. Pioneers such as Suppes (Stanford University) set standards for subsequent instructional software. After systematically analyzing courses in arithmetic and other subjects, Suppes designed a highly structured computer system featuring learner feedback, lesson branching, and student record keeping. During the mid 1970s, a particularly widespread and influential source of CBI known as “Plato system” was developed at the University of Illinois. The system included hundreds of tutorial and drill-and practice programs. Like other systems of the time, “Plato systems” were available on mainframe computers. The early CBI programmes were rudimentary by today's standards (Ayariga, 2010).

As computer technology evolved, so did computer-based instruction. Today, the Computer-Based Instruction Model is used by myriad of learning programs throughout the world. Any instructional program that includes the use of a computer –CD-ROMs, DVDs, etc. is based on this concept, which can also be implemented in conjunction with traditional teaching methods to enhance the overall educational experience. Computers can also be used in the workplace, to educate employees about new work practices or regulations that must be followed within their professional environment. More complex lessons can also be delivered via computers, allowing instructors to educate their learners in a more effective and profound way. Even students who are unable to attend school or individual courses are given the chance to learn through Computer-Based Instruction schemes. Some of the uses of CBI include simulations simplified representations of real situations, processes, etc., tutorials enriching background knowledge, ideal for verbal and conceptual learning, as well as for simultaneous attendance, providing immediate feedback, instructional games providing motivation elements, such as competition, cooperation, etc., substituting exercises, and inspiring goal-setting, creativity, and respect for rules and designed to promote problem-solving abilities for a variety of situations (Kulik & Kulik, 1991).

2.5 The Use of Computers in the Teaching and Learning Process

The rapid development of technology as noted by Kankaaranta (2005) has challenged learning environments to adopt ICT to support learning and teaching and in guiding children to become diversified users of technology. The influence and impact of technology on our society have affected the educational system in no small way. Voogt and van den Akker (2001) therefore noted that it is generally accepted that the increasing impact of ICT on our society is also influencing teaching and learning. Schools use ICT especially computers in various ways. The computer has now become an integral part of the school system in almost every country. The computer has many purposes in the classroom, and it can be utilized to help a student in all areas of the curriculum (Tabassum, 2004). The role of computers in education is captured more succinctly by Traynor (2003) when he stated that computers are used not only as a means of helping schools analyze data; but computers have become a pervasive tool toward optimizing student learning.

The use of computers in education is steadily increasing (Tondeur, Van Braak & Valcke, 2007). Teachers and school administrators use computers in different ways and that since the introduction of computer use in education in the 1960s; its terminology has continuously evolved (Voogt & van den Akker, 2001).

Since the use of the computer in the school has become necessary, it is very prudent that the various types of educational use of the computer are explored.

Thomas (2001) indicates that authors outline the potential value of the computer in terms of specific task(s) that the computer, its associated interfacing and where necessary other associated apparatus can perform for students. van Braak, Tondeur and Valcke (2004) identified two different types of computer use by teachers. They found out that there is the 'class use of computers' whereby teachers use computers as a tool for presentation and instructing pupils in the possibilities of computers. The other way teachers use computers was what they termed the 'supportive use of computers'. In this, van Braak et al. (2004) revealed that teachers use the computers for administration purposes, preparing worksheets for the pupils and looking for information on the internet for lesson preparation. It could be seen from these uses that, the emphasis was on the teacher. The teacher is the one who uses the computer to facilitate his or her teaching. The student is taught the computer as a subject. The student is more or less instructed on how he can use the computer to present assignments or search for information.

From the point of view of Baron and Bruillard (as cited by Tondeur, van Braak & Valcke, 2007), any evaluation of computer usage in education depends on its educational uses as defined by society. Based on this, Tondeur, et al. (2007) analyzed some international computer curricula to find out the aims of computer education. They found out two main aims. One of them was that, children will become digitally literate in order to be prepared for a knowledge-based society. The other aim indicated that computers should be incorporated in the curriculum. Based on these aims, Tondeur et al. (2007) derived two types of computer usage in education. These are computers as a school subject and computers as an educational tool.

The computers as a subject seek to emphasize learning about the computer and its uses. In this, the computer is taught as a separate and distinct subject just like mathematics or biology. This type of computer usage seeks to teach the student how to use the computer, the various parts and the basic functions of the computer parts and functions of the computer in general.

The computer as an educational tool seeks the use of the computer in the teaching and learning process. This encompasses the various modes by which the teacher can use the computer to facilitate the teaching of his or her lessons as well as how the computer can help the students maximize their learning. The computer as an educational tool is thus used to enhance the teaching and learning process and that it may fit into a spectrum of instructional approaches, varying from traditional to innovative (Tondeur, van Braak &

Valcke, 2007). These approaches range from using power point to teach through drill and practice to complex simulations (Ornstein & Levine, 1993).

It could be seen that the usage of the computer in this direction can be categorized into two main areas: learning about computers and learning through computers (Goldberg & Sherwood, 1983; Tabassum, 2004).Learning about computers thus deals with the idea of teaching students about computers as a separate and distinct subject to the student. The teacher thus teaches the students what they should know about the computer including the names of the various parts, how to use the keyboard and how to use computer packages among other things as may be prescribed by the prevailing computer curriculum. Learning through computers is the situation whereby the computer is used in teaching the student. In this approach, the computer is used to present the material to be learnt to the student.

Ornstein and Levine (1993) observed that the role of the computer has been envisioned in terms of three areas of application. These include tool application, computer-managed instruction and computer-assisted instruction. According to them, in the tool application, also called learning about computers (Goldberg & Sherwood, 1983; Tabassum, 2004) the computer is used as a personal assistance device. In the tool application mode, students are taught computer and its applications. It could be seen that the usage of the computer in this direction can be categorized into two main areas. These include: learning about computers and learning through computers (Goldberg & Sherwood, 1983; Tabassum, 2004). Knowledge of computers may be thought of as a continuum, and it ranges from skills in and awareness of computers at lower level to programming at higher level (Tabassum, 2004). The computer can be used in presentation in multiple forms and data analysis (Thomas, 2001). Application packages like SPSS and Excel are used to analyze data. Voogt and van den Akker (2001) assert that data presentation packages, word processor and other applications support students in their capability to structure information, and to easily present information in different formats. Students and teachers alike always use the internet to search for information for assignments and research. Voogt and van den Akker (2001) believe that teachers who use the internet can guide their students from remote locations creating new possibilities for distance education. Moreover, students and teachers can exchange messages among themselves through the internet. Thus the use of the computer through the internet has become formalized in the everyday practice of teaching and learning. Again, there is the avenue for video conferencing which can be useful in collaborative learning environments and also used to facilitate distance learning.

Also, in tool application the students use the computer to write reports, do homework, solve mathematical problems, and present reports like long essays and term essays while teachers may use the computer to search for information and present learning materials in power point format. Ornstein and Levine (1993) state that the use of the computer as a tool application is a personal decision on the part of students and not one requested by the teacher. This indicates that the use of the computer as a tool application rests mostly on the decision of the student. The student decides whether to use the computer or not unless the teacher demands that a report should be presented in a format that demands the use of the computer. Moreover, the teacher may refer the students to his or her own web-site for assignments or reading materials.

The second way that the computer can be applied in education is in a process termed computer-managed instruction (Ornstein & Levine 1993). They define this usage as the system control and organization of instruction, characterized by testing, diagnostic data, learning prescriptions and thorough record keeping. They believe that the computer can monitor, test, prescribe programmes for and keep records of more than 100,000 students if the computer has sufficient memory and storage capacity. In this approach, the computer takes centre stage in the teaching process. The computer controls the instruction and tests the students and goes further to diagnose student's problems.

Under computer managed-instruction, Thomas (2001) and Voogt and van den Akker, (2001) indicated that the computer can be applied in education in what is known as microcomputer-based laboratory (MBL). The microcomputer-based laboratory includes computer programme which records events automatically in order to provide an audit trail. The computer is used as a support tool for students' laboratory work. It becomes much easier to repeat experiments, to measure different variables at the same time, to use a very short or very long time ranges, to analyze data and to represent data graphically (Voogt & van den Akker, 2001). The records that will be derived can be used to diagnose student problems.

Thirdly, the computer can be used in education in a process called Computer-Assisted Instruction (CAI). In the CAI mode, the computer is used in the teaching of the student (Ornstein and Levine 1993). Goldberg and Sherwood (1983) and Tabassum (2004) call this application learning from the computer. According to Soe, Koki and Chang (2000) "learning from computers encompasses approaches to computer-assisted instruction in which the computer is used as a means for transmitting specific subject matter." In this approach, the flow of information is basically from the computer to the student. The computer presents the learning materials or activities for students to which the latter responds. During the course of the interaction, the computer retains records of the student's progress (Soe, Koki & Chang, 2000). Ornstein and Levine (1993) believe that CAI emphasizes tutoring and/or drill and practice programmes and is appropriate when subject matter needs to be mastered or for practice of basic skills before advancing to higher levels of learning. Computer-assisted instruction as indicated by Cotton (1991) is rather and most often refers to drill and practice, tutorial, or simulation activities offered either by themselves or as supplements to traditional, teacher directed instruction. Voogt and van den Akker (2001) indicated that drill and practice and tutorial software programmes serve as an assistant for teachers by taking over some of their tasks. Thus in the CAI mode, the computer can more or less teach the students literally as in the tutorial application or it can be used to assist the teaching of the student as in drill and practice.

In the drill and practice mode, it is assumed that the students have been taught previously and further practice is needed for mastery. Tabassum (2004) indicates that the students must be familiar with certain concepts prior to working with drill and practice packages in order to understand the content. The drill and practice use of the computer emphasizes individualized learning where the student moves at his or her own pace; and offer the practice of basic knowledge and skills (Tabassum, 2004 & Voogt & van den Akker, 2001).Thus, the computer becomes an assistant to the teacher. There are facilities in the drill and practice software that provide feedback to the learners to keep track of their performance (Voogt & van den Akker, 2001). Thus, the drill and practice more or less acts as an assessment tool. According to Sharp (as cited by Tabassum 2004) the typical drill and practice programme design includes four steps:

(1) the computer screen presents the student with questions for responses or problems to solve;

(2) the student responds;

(3) the computer informs the student whether the answer is correct or not; and

(4) if the student is right, he or she is given another problem to solve, but if the student's response is wrong, he or she is corrected by the computer.

2.6 Effect of CBI on Learners' Misconceptions and Cognition

Tirosh et al. (1990) reported that the use of CBI has the capacity to improve learners' performance and correct misconceptions that they harbour through a planned and structured computer programme. According to Demirci (2005), before taking an introductory physics course, students had many misconceptions related to their own previous experiences or knowledge, and normal traditional lecturing fails to overcome those difficulties. Based on the data obtained in his study, it was observed that incorporating the web-based physics programme decreased students' misconceptions, and increased their achievements. These can be implied that using new instructional methods such as incorporating the web-assisted physics programme with the traditional lecturing can remit students' misconception in force and motion concepts.

A research by Hicks and Laue (1989), Finegold and Grosky (1988) and Scott et al. (1992) showed that the use of Computer Based Instruction dispels students' misconception about force and motion. A work by Kahraman and Demir (2011) on students' misconceptions on atomic structure and orbital showed that computer based instruction has positive effect for remedying such misconceptions.

Bigum (as cited by Thomas, 2001) indicated that when a new technology appears on the market, various arguments are made to indicate how that technology will enhance learning.

In the light of this, Tabassum (2004) indicated that advocates of computer assisted instruction (CAI) or CBI have high expectations for the computer as an instrument for identifying and meeting individual needs. Thus, since proponents of CBI argue that their mode of instruction improve students' learning, many researches have been conducted to ascertain the truthfulness of this claim.

The outcome of these researches indicate that CAI is not uniformly effective in that some studies show no significant differences in achievement between CAI and non-CAI students (Ornstein & Levine, 1993), especially those studies that compared CAI alone against conventional instruction (Cotton, 1991; Danley & Baker, 1988). However, it has been found out that student achievement increases when CAI is used in addition to or supplement the conventional instruction (Bontempi & Warden-Hazlewood, 2003; Cotton, 1991; Ornstein & Levine, 1993; & Tabassum, 2004).

As noted by Ornstein and Levine (1993), the effect of CAI with regard to achievement is not uniform. This trend comes about as a result of how the CAI is applied (Lowe, 2001); whether on its own or as a supplement to conventional instruction. Goode (1988) found out that when used CAI was used, students scored significantly higher in mathematical concepts and computation than students who went through the traditional approach. This indicates that the students that were instructed through CAI performed better on the mathematical concepts as compared to those students who were instructed through teaching strategies such as lecture or questions and answer method. In a related study, Harrison (1993) also found out that, students who received computer instruction showed greater increase in their achievement scores in multiplication and subtraction than students who received traditional mathematical instruction. These studies indicate that CAI is capable of improving students' achievement.

Other studies also confirm these findings. Kausar, Choudhry and Gujjar (2008) indicated that CAI proved to be significantly superior to classroom lecture in terms of achievement in knowledge, analysis and synthesis of the Bloom's taxonomy when they conducted a comparative study to evaluate the effectiveness of computer-assisted instruction versus classroom lecture for computer science students. In terms of evaluation and application skills, they found out that CAI proved to be very much effective in increasing those skills as compared to classroom lecture. This study seems to suggest that CAI is able to improve student achievement and performance.

Kulik and Bangert-Drowns (1983) found that CAI has the potential of improving students' achievement scores in pre-college classes. Roberts and Madhere (as cited in Jenks and Springer, 2002) stated that their findings indicate marginal successes in academic gains in reading and mathematics. Brophy (as cited in Jenks & Springer, 2002) indicated that CAI is effective in science lessons. In social studies settings, Stern and Repa (as cited in Jenks and Springer, 2002) showed that CAI was successfully used to teach social skills to teens enrolled in a behaviour modification programme. This implies that the benefit of CAI is not limited to only one subject area.

The effect of CBI is also not limited to the lower levels of education only. Ivers and Barron (1998) reported that significant learning increases when pre-service teachers worked in a paired condition using computer based instruction that was designed for learning.

2.7 CBI Design

CBI design is defined as the programming of content and lesson design that considers the individual differences of the learner to achieve the learning goal level delivered by computer. Critical for promoting achievement in CBI are features that provide opportunities for problem solving, corrective feedback, elaboration, visual and graphic cues, control of the routine by the learner, and appropriate wait time between input and response (Lewis, 1990). The design of CBI should be based on a planned and structured instructional approach with features of visual simulations to remedy the cognition needs of learners (Demirci, 2005).

This unit of the model makes CBI different from other forms of individualized instruction. CBI design is comprised of four components: instructional control, instructional support, screen design, and practice strategy. Instructional control can be program controlled where the program guides the learner; learner controlled where the learner determines the options; or adaptive controlled that is a combination of program and learner controlled where control is based on the learner's responses. CBI that is adaptive or intelligent to student's responses and rate of learning is twice effective (Ayariga, 2010).

Ybarrondo (1984) developed a CAI material on Evolution. In this, the material was made up of tutorials and simulation. The material was compatible with Apple II + computers. The simulation programme allowed learners to simulate the effects of natural selection. The tutorial section had texts which explained concepts. Moreover, there was drill section in the tutorial. This enabled learners to progress or to read the material again based on their performance on the drills. Collins and Earle (as cited in Andrews and Collins, 1993) also developed a number of CAI in biology for Memorial University. Their courseware was developed with PC/PILOT and is compatible with IBM and APPLE II computers.

Moreover, they have developed courseware for a number of biology topics including: The Cell, Taxonomy, Protein Synthesis, Respiration, Genetics and Plant Biology. Morrell (1992) also developed a CAI tutorial for her students in order to find out the effects of computer-assisted instruction on student achievement in High School Biology. The CAI was developed in the Applesoft BASIC computer language. The tutorial covered areas in photosynthesis and genetics. This software included graphics and text. Moreover, a self test quiz was included to enable students to assess themselves as they learnt the material. Imhanlahimi and Imhanlahimi (2008) also developed a CAI material in Biology for their study. The material covered the topics photosynthesis, micro-organisms in air and water and digestive system. In developing the material, they prepared a highly structured lesson notes for each of the topics and copied them on to a diskette. The material included questions, experiments and diagrams to facilitate student understanding (Imhanlahimi & Imhanlahimi, 2008).

In order to ensure that terminologies used in the courseware were not different from those that teachers use in the classroom since such a situation can cause real problems and moreover since commercial software are expensive the researcher developed his own course ware. This course ware was developed based on the topic Cell Cycle. It incorporated texts, hyperlinks and animation. The material was a tutorial with drills. Windows Power Point 2003 and its associated macros were used to develop the course ware (Andrew & Collins 1993).

2.8 Categories of CBI Software

According to Alessi and Trollip (2001), there are four main categories of CBI software. These include 'Drill-and Practice', Flexible Practice', 'Simulation', and 'Multimedia'. The 'Drill-and-Practice', category is largely machine-determined and provides instruction in a manner dictated entirely by the software author and the machine itself. For example the computer displays series of chords which become a stimulus to which the student is asked to respond by indicating the chord types or perhaps their functions. If the student answers correctly, the software might provide a new set of chords that is more challenging. If any of the responses are incorrect, the software might branch off to an easier set. This category of software provides an efficient and direct means of inspiring specific skills. Key characteristics typically include: stimulus/response approach with rewards or penalties, simple to complex tasks focusing on one set of skills, and branching to additional drills based on success or failure.

Software in the category of "Flexible Practice" has the purpose of skill development, as it adds features that allow flexibility of use for an instructor and for the student seeking-improvement. Furthermore, this category is student and teacher-centered in that it provides choices that permit individuals to have a hand in engineering their own learning. For instance, students might use their own understanding of weaknesses in chord identification to establish a special set of drills. Flexible Practice Software (FPS) typically provides menus and dialog because that lets students choose the settings for series of exercises that best suit their needs. In a similar way, teachers can use these features to create tailor-made curriculum for an individual or class.

Key characteristics typically include: Stimulus/response items, but with flexible settings for performance, comprehensive approach with multiple tasks, intelligent branching tailored to individual needs, flexibility for student and teacher in designing learning environment. The most recent category of CBI to emerge is simulation, though simulation software has been around for a number of years in other disciplines, particularly science and mathematics education. Perhaps the most famous example of simulation software comes from the social sciences in the form of games, for example 'SimCity' and 'SimEarth'. On these games, the software provides choices in the initial design, maintenance, and growth of an imaginary urban or global environment. Other application software for example, 'Earpo' takes a similar approach. Rather than focus on specific skill development in the form of drills, simulation software takes a more holistic approach (Alessi &Trollip, 2001).

Multimedia software is a unique merger of learning resources. Text information can be augmented with graphics, including drawing, photographs, animation, and motion video. The kind of application has attracted the attention of many educators because of its capacity to integrate large amounts of aural, visual and written information into one application. All these categories of CBI software are accompanied by audio and video stimulus which helps to enhance memory and eliminate boredom in teaching and learning. Furthermore, one can deduce that CBI software has one major characteristic which is its ability to be interactive. For example, it offers immediate feedback, notes incorrect responses and tests. This characteristic is noted with all the four categories of CBI which are 'Drill-and-Practice', 'Flexible Practice', 'Simulation' and 'multimedia'. It has been established that there are four main categories of CBI software being used in the Western countries to enhance both teaching and learning. However, in Ghana, a research by Ayariga (2010) showed that none of the four categories of CBI is being used to enhance teaching and learning.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter describes the research methodology employed in the study. It covers the research design, population, sample and sampling procedure, instruments, data collection, data analysis procedures and validity and reliability of the study.

3.1 Research Design

The research design that was used for the research was quasi-experimental design since the subjects were not assigned randomly to pretest-posttest equivalent group (Creswell, 1994). This design was used to collect quantitative data for the study based on studies from Kauser, Choudhry and Gujjar (2008). It was chosen because it controls Hawthorne effect which is a threat to validity (Campbell & Stanley 1966).

3.2 Population

Nkawkaw Municipality (the study environment) has about 16 JHS schools (6 public schools and 7 private schools). The target population was about 900 JHS pupils (all the JHS pupils in the study environment), and the accessible population was about 70 pupils (all the JHS pupils of a selected school).

3.3 Sampling

Purposive sampling was used for the selection of schools for the study since a survey in the Municipality depicted that most schools in the municipality lacked computer facilities suitable for the study. Following this, one private school (the only school with adequate computer facilities suitable for the study) was selected. JHS three pupils were selected because (based on the academic scheme of work of the school) they had been taught 'diffusion', and this was needed for the study. The JHS three pupils were 23 and this formed the sample size.

The name of the subjects and the school were not mentioned in this study following ethics of research as indicated by Siegle (2008).

3.4 Instruments

The researcher used pretest and posttest test items to determine the possible misconceptions. He adopted the pretest and posttest questions from Odom et al. (1993) who developed the pretest questions by changing validated propositional knowledge statements on diffusion into pretest questions and slightly, altering the pretest questions to form the post-test questions (Appendix B & C). A readability close test was conducted with a pilot group to ensure that the test items were at the standard of the JHS 3 pupils.

The pretest was conducted before the treatment. Through this, pre-treatment data and the pupils misconceptions were determined. And after the treatment, a post-test was also conducted to obtain the post-treatment data. Each was for one hour test.

3.5 Validity and Reliability

The researcher adopted the pretest and posttest questions from Odom et al. (1993) whose test items were developed from validated propositional knowledge statements on diffusion; they indicated that the pretest questions, posttest questions and the validated propositional knowledge statements were developed by consulting two Biology Professors and two

Biology tutors. They also indicated that the pretest questions were slightly altered to develop the posttest questions to prevent the effect of maturation.

In collecting the quantitative data, efforts were made to avoid effects that are threat to validity. For example, the researcher used non-randomized group to prevent Hawthorne effect. He also used paired samples to prevent the effect of confounding variables.

Efforts were also made to avoid effects that are threat to reliability. For example, the identities of the subjects were not familiarized during the marking to prevent negative and positive Halo effects.

A pilot study of a neutral school was also employed to rectify any problem to enhance reliability for the CBI software. A test on Information and Communication Technology (ICT) was conducted for the experimental group to determine their knowledge on computer to ensure that the software could be used for them.

3.6 Treatment

The treatment was a two period class (70 minutes class). In the first 15 minutes of the instruction period, pupils were guided on how the software is used. In the next 55 minutes, pupils used the software by interacting with the computer. The instruction was therefore student-centered approach. Pupils had the opportunity to discuss challenging aspects of the concept; they also had the opportunity to revisit the lesson from time to time for effective understanding until the allotted period for the instruction was consumed. The following depict the nature of the software.

3.6.1 Development of the software

The researcher adapted the CBI software (appendix E), which was developed by Andrew and Collins (1993). This was because: some changes had to be made to achieve the objectives of the study. Some of the changes include the following:

1. The objectives and the core points of the software's content were changed so as to directly address the misconceptions of the pupils.
2. A page explaining the use of the arrows and buttons was added to show them where they should move their mouse to and how to click to enable commands in the software, showing them exactly how to navigate through the various menus.
3. Some visual simulations and animations which were irrelevant for this study were removed.
4. Power point was used to replace web pages because it is easy to create slides with, and it can be used to make the software .run easily.

3.6.2 The Software Design

The software was designed with power point pages with arrows, button and statement commands which enabled the pupils to study without an instructor. The items (buttons and arrows) in the content of the software pages were hyperlinked to each other. However, if any word is underlined in the software, it is an indication of it being hyperlinked.

3.6.3 Content of the software

The contents of the software were based on the identified misconceptions. The objectives and the core points of the software's content laid emphasis on the identified misconceptions. The misconceptions were:

1. Diffusion only occurs in non-living systems since they occur in only gases.
2. Concentration has no effect on diffusion.
3. Diffusion rate decreases as temperature increases.
4. Diffusions only occur in living systems
5. Diffusion is the opposite of osmosis

They held the first and the fourth misconceptions because it could be that they did not know much about living and nonliving systems examples of diffusion. Similarly, studies from Demirci (2005) shows that if learners have much knowledge about the examples and applications of diffusion or osmosis, it will assist them to know whether they occur in both living and nonliving systems. For this reason, the core points of the software incorporated some examples of diffusion and the ones that occur in living systems and nonliving systems were indicated.

They also held the second and third misconceptions because it seemed they did not have much knowledge about the factors that affect diffusion. Due to this, the core points of the software contains the factors that affect diffusion and how the factors affect diffusion was indicated; this could help them to know how temperature and concentration affect diffusion so that the misconceptions can be dispelled. They held the forth misconception because it appears they did not have much knowledge about the difference between diffusion and osmosis. Following this, the difference between diffusion and osmosis was indicated in the software core points.

Similarly, the objectives of the content of the software also sought to address the misconceptions held by the pupils. The objectives were:

At the end of the lesson, pupils should be able to:

1. state whether or not diffusion occurs in both living and non living systems
2. state how concentration and temperature affect diffusion
3. differentiate between diffusion and osmosis

3.6.4 The Software Operation

A click command on the arrows and buttons takes moves from one page to another. The students have the opportunity to go back to previous pages until the content is thoroughly understood. These items (arrows and buttons) are the basis for the operation of the software and as indicated in the help page of one of the software pages. The function of one item differs from the other.

The software's items and functions include:

 takes the operator to the previous page.

 takes the operator to the next page.

EXIT ends the lesson and takes the operator out of the software pages.

starts the lesson.

3.7 Data Collection Procedure

Permission was sought from the Heads of the schools to conduct the research in their schools. Consent was also sought from the class teacher. The pretest, treatment and posttest were administered to the group after permission had been given.

The researcher used pretest items to collect data on the pupils' misconceptions and that was a procedure adopted from Treagust (2014), Demirci (2005) and Odom et al. (1993). The answers given by the pupils were compared to validated propositional knowledge statements on diffusion. Answers which did not conform to the validated statements depicted the misconceptions; answers that showed conformity and those that showed no idea were not taken as misconceptions. After the pretest, the treatment which involved the use of the CBI was conducted. Post-test items were used to collect data after the treatment was administered.

3.8 Data Analyses

The researcher used descriptive statistics to analyze data inferential statistics (paired sample t-test analysis) to analyze statistical significance of the data. The inferential statistics encompassed paired sample t-test because the same group was used before and after treatment and this was based on studies from Zaiontz (2014).

First, line graphs were used to present the pre-treatment and post-treatment data; this showed the trends of the scores. They were presented graphically and in tables. The graphs were presented in the results and the tables were sent to the appendix D. This was in accordance with studies from Bur (2005) which depicted that; if there is a simultaneous presentation of a data in graphs and tables, then preferably, the graphs should be presented in the result and the tables should be sent to the appendix; they should not be presented concurrently.

The results of this analysis are shown in the next chapter.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter provides the results and discussions of the study based on the research questions and the null hypothesis.

4.1 JHS pupils' misconceptions on diffusion

Sixty percent of the pupils held 5 misconceptions; which include:

1. Diffusion only occurs in non-living systems since they occur in only gases.
2. Concentration has no effect on diffusion.

3. Diffusion rate decreases as temperature increases.
4. Diffusions only occur in living systems
5. Diffusion is the opposite of osmosis

For the first, second, third and forth misconceptions, learners held the same misconceptions in the findings of Demirci (2005), and for the fifth misconception, learners held the same misconception in the findings of Wandersee (1998). This is coherent to a report Odom, Arthur, Barrow and Lloyd (1993) who concluded that learners hold misconceptions on diffusion. In line with this, the first research question (what are JHS pupils' misconceptions on diffusion?) appears to have been answered.

4.2 Effect of CBI on JHS pupils' misconceptions

The effect CBI has on JHS pupils' misconceptions on diffusion can be evident from the pupils' pretest and post-test data. These data seek to answer the second research question (what effect does CBI has on the pupils' misconceptions?) and they have been graphically presented (figure 1, 2 &3). The effect has also been statistically analyzed (table1), and thorough this, the null hypothesis (CBI has no significant effect on JHS pupils' misconceptions on diffusion) has been established. These are presented below:

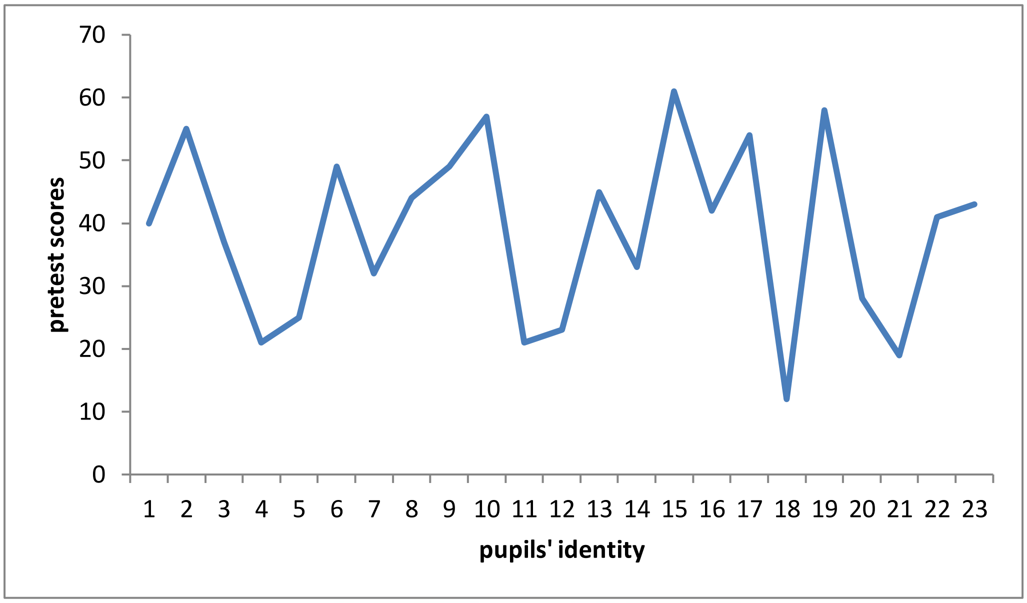

Figure 1: A graph showing the trend of pretest scores of the pupils

From the graph, it can be seen that the pre-test scores ranged from (12-61) %; implying that the highest score was 61% and the lowest score was 12%. Eighteen pupils got marks below 50% and the remaining five pupils got above 50%; implying less than 50% of the pupils got scores above 50%.

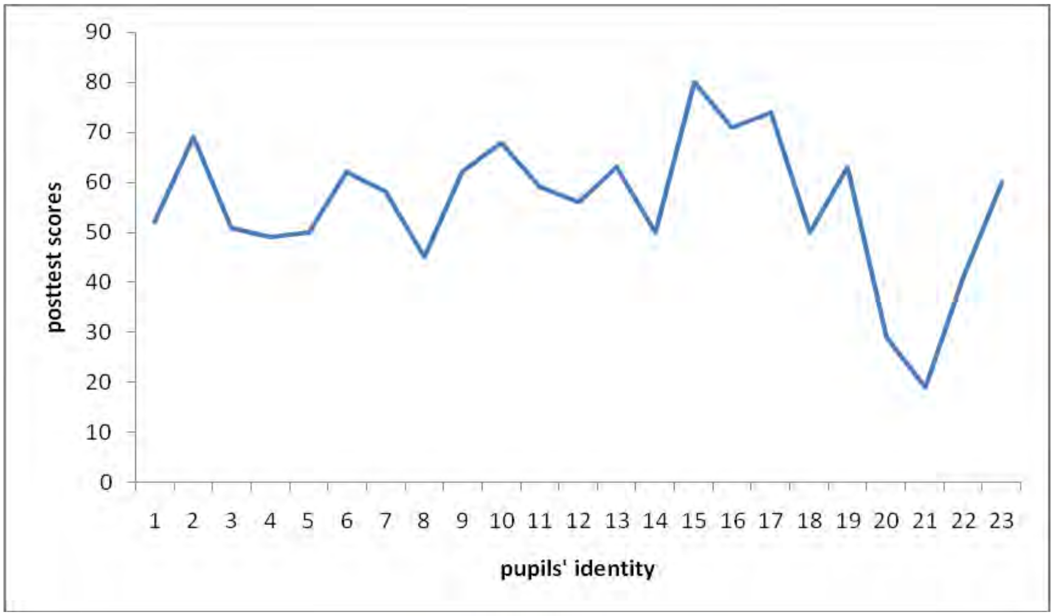

Figure 2: A graph showing the trend of posttest scores of the pupils

From the graph, it can be seen that the posttest scores ranged between19-74; implying that the highest score was 74% and the lowest score was 19%. Five pupils got marks below 50% and the remaining eighteen pupils got above 50% indicating that more than 50% of the pupils got scores above 50%.

Figure 3: A graph showing the comparison of pretest and posttest scores of the pupils

From figure 3 (the blue line represents the pretest and the red line represents the posttest), it depicts that comparatively, the pupils improved their performance after the treatment and performed better in the post-test. However, based on their answers to the post test items, the misconceptions were removed. It appears that the removing of the misconceptions after the treatment made them to improve their performance in the post-test. This is in conformity to the findings of Berthelsen (1999), who concluded that if students harbour science misconceptions without a remedial by planned teaching methods, they perform poor in examinations following elements of misconceptions which portray in their minds and become evident in their answers. The findings were also coherent with that of Engel

(1992) who concluded that if students use CBI, they will have the opportunity to dispel their misconceptions that will help them to score high marks in examinations.

The pupils' held misconceptions although their science teacher had previously used the conventional teaching method to teach them the concept. It seems this happened because the approach was not effective and so this made them to score low marks in the pretest. It could therefore be that, the pupils had the opportunity to dispel the misconceptions based on the understanding they seemed to have with the use of the CBI. This may imply that the CBI has effect on JHS pupils' misconceptions because it can dispel their misconceptions.

Table 1: A table showing a t-test: paired two sample for means

	Posttest	Pretest
Mean	55.69565	38.65217
Variance	194.4032	198.9644
Observations	23	23
df	22	
t Stat	7.110731	
P(T<=t) one-tail	1.97E-07	
t Critical one-tail	1.717144	
P(T<=t) two-tail	3.94E-07	
t Critical two-tail	2.073873	

Based on the table above, the standard deviation (t Stat) is 7.11073 and the critical value (t_{crit} or t Critical two-tail) is 2.073873 implying that t Stat > t_{crit}.. Similarly, the probability value (p-value) is 3.94E-07 implying that p-value<0.05. This implies that there is significant difference between the pretest scores and the posttest scores of the pupils. It could be that this was made possible due to and effective removal of those misconceptions by the CBI. For this reason, we reject the null hypothesis and conclude with 95% confidence that CBI has significant effect on JHS pupils' misconceptions.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This is the concluding chapter of the thesis. It encompasses the summary, conclusions as well as the recommendations of the study.

5.1 Summary

This briefly emphasizes on the purpose, problem and the methodology of the study. It also links the research questions and the null hypothesis to the findings of the research.

The purpose of this study was to determine the effect of computer based instruction on Junior High School (JHS) pupils' misconceptions on diffusion. The research problem emphasized that pupils of JHS appeared to hold misconceptions in diffusion and so there was the need to use CBI to dispel the possible misconceptions. Quasi-experimental design was used to collect quantitative data, and so the subjects were not assigned randomly to pretest-posttest equivalent group. Diagnostic test was used to identify the pupils' misconceptions.

The first research question sought to ascertain whether JHS pupils hold misconceptions on diffusion. And it was found that the pupils were holding the misconceptions. The second research question sought to know if CBI has effect on the misconceptions. The findings show that CBI has effect on pupils' misconceptions since it was able to dispel their misconceptions. The null hypothesis was that: CBI has no significant effect on the misconceptions. This was rejected because a statistical significance, established using a paired sample t-Test show that it has significant effect on the misconceptions.

5.2 Conclusions

Based on the findings of this study, the following conclusions were reached:

The JHS pupils of Nkawkaw municipality according to this study hold misconceptions on diffusion and CBI is effective on dispelling such misconceptions. And so, by using CBI with a content which addresses the misconceptions, the pupils will have the opportunity to acquire an understanding which will help them to remove the inherent misconceptions.

5.3 Recommendations

Based on the findings of the study, the following recommendations are made:

1. There is the need to use CBI in the teaching of science concepts in this study area as well as other areas so that misconceptions can be prevented. However, if misconceptions are identified among pupils, CBI should be used to remedy them.
2. Science teachers and teachers of other subjects in the study area and other areas should be trained in the development of CBI materials so that they can adapt existing materials to teach science concepts to equip learners in order to prevent misconceptions.
3. Pupils should be given more time to learn Information and Communication Technology (ICT) so that the CBI can be used for them easily.

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APPENDICES

APPENDIX A: Propositional Knowledge Statements Required to sophisticate learners on Understanding Diffusion

1. All particles are in constant motion.

2. Diffusion involves the movement of particles.

3. Diffusion results from the random motion and/or collisions of particles (ions or molecules).

4. Diffusion is the net movement of particles as a result of a concentration gradient.

5. Concentration is the number of particles per unit volume.

6. Concentration gradient is a difference in concentration of a substance across a space.

7. Diffusion involves net movement just as osmosis but some distinguishing features include: it does not require a semi-permeable membrane and movement involves only water molecules.

8. Diffusion continues until the particles become uniformly distributed in the medium in which they are dissolved.

9. Diffusion rate increases as temperature increases.

10. Temperature increases motion and/or particle collisions.

11. Diffusion rate increases as the concentration gradient increases.

12. Increased concentration increases particle collisions.

13. Diffusion occurs in living and nonliving systems.

APPENDIX B: Pretest Questions

NAME OF SCHOOL ....TIME: One and half Hour.

Answer all questions. Each question carries equal marks.

1. During diffusion what happens when particles become uniformly distributed in the medium in which they dissolve?

2. Define the term concentration gradient.
3. Define the term diffusion.
4. How does temperature affect motion and/or particle collisions?
5. What is the nature of motion of all particles?
6. Define the term concentration.
7. State whether or not there can be net movement of particles without a concentration gradient.
8. What happens to the collision of particles when concentration increases?
9. State whether diffusion can occur in both living and non-living systems
10. How does temperature affect the rate of diffusion?
11. How does concentration gradient affect diffusion?
12. State whether or not diffusion results from the random motion and/or collisions of particles.
13. State one difference between diffusion and osmosis

APPENDIX C: Posttest Questions

NAME OF SCHOOL ....TIME: One Hour.

Answer all questions. Each question carries equal marks.

1. What is concentration?
2. What will happen when there is concentration gradient?

3. Between living and non-living systems, identify where diffusion occurs?
4. How does decreased temperature affect motion and/or particle collisions?
5. Identify the nature of motion of all particles?
6. How does diffusion affect uniform distribution of particles in a medium?
7. How does decreased concentration gradient affect diffusion?
8. How does increased concentration affect collision of particles?
9. Distinguish between diffusion and osmosis.
10. What will an increased temperature do to the rate of diffusion?
11. What is diffusion?
12. What will happen if there are random motion and/or collisions of particles?
13. What do you understand by the term concentration gradient?

APPENDIX D: A table showing pretest and posttest scores

Pupils' identity	Scores (%)	
	pretest	posttest
1	40	52
2	55	69
3	37	51

4	21	49
5	25	50
6	49	62
7	32	58
8	44	45
9	49	62
10	57	68
11	21	59
12	23	56
13	45	63
14	33	50
15	61	80
16	42	71
17	54	74
18	12	50
19	58	63
20	28	29
21	19	19
22	41	41
23	43	60

Table 2

APPENDIX E: The computer software developed for the use of the CBI

THE COMPUTER SOFTWARE PAGES DEVELOPED FOR THE CBI

DEVELOPED BY:

JULIUS ODOI

(M.ED STUDENT)

FACULTY OF SCIENCE EDUCATION

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EXIT

WELCOME TO TUTORIALS ON DIFFUSION

HELP PAGE

This button takes you to the Title Page .... Home

This button takes you to the Previous Page .... 

This button takes you to the Next Page .... 

This button takes you to the Exercise Section .... 

This button starts the lesson .... Start lesson

 Home 

OBJECTIVES

By the end of this tutorial, you should be able to:

1. state whether or not diffusion occurs in both living and nonliving systems

2. state how concentration and temperature affect diffusion
3. differentiate between diffusion and osmosis

NB:

RAISE YOUR HAND WHEN YOU HAVE ANY QUESTION

REQUIREMENT:

YOU SHOULD HAVE A PEN AND A NOTEBOOK TO TAKE NOTES AND DO EXERCISES.

IF YOU MEET THE REQUIREMENT START LESSON.

Home

Start lesson

WELCOME TO THE LESSON

DIFFUSION

Diffusion is the net passive movement of particles (atoms, ions or molecules) from a region in which they are in higher concentration to regions of lower concentration. Diffusion is a passive transport because the molecules require less energy for transmission. It continues until the concentration of substances is uniform throughout.

The tendency towards diffusion is very strong even at room temperature because of the high molecular velocities associated with the thermal energy of the particles. Diffusion continues until the particles become uniformly distributed in the medium in which they are dissolved. Concentration is the number of particles per unit volume. Concentration gradient is a difference in concentration of a substance across a space. Diffusion can also be termed as the net movement of particles from an area of high concentration to an area of low concentration.

Home

Examples of diffusion

Some major examples of diffusion include**:**

1. Gas exchange at the alveoli — oxygen from air to blood, carbon dioxide from blood to air.
2. Gas exchange for photosynthesis — carbon dioxide from air to leaf, oxygen from leaf to air.
3. Gas exchange for respiration — oxygen from blood to tissue cells, carbon dioxide in opposite direction.
4. Transfer of transmitter substance — acetylcholine from presynaptic to postsynaptic.
5. Movement of particles of body perfume and burning mosquito coil.

NB: Examples 1-3 occurs in living systems, but example 4 and 5 occurs in non living systems

Home

Factors that affect diffusion rate

The factors that affect diffusion include:

- temperature
- state of matter
- distance
- particle weight and size
- concentration
- concentration gradient

How these factors affect diffusion

- High temperatures increase diffusion rate.
- Longer distance gives rise to lower rate of diffusion and the shorter distance gives rise to higher rate of diffusion.
- The larger the particle size, the lower the rate of diffusion.

Home

- Increased concentration of particles increases their collisions and hence the rate of diffusion.

- Diffusion increases with increasing concentration gradient.

Difference between diffusion and osmosis

While diffusion can be defined as the movement of particles from an area of higher concentration to an area of lower concentration, osmosis is the movement of molecules of a liquid solvent (water) from an area of lower concentration to an area of higher concentration across a semi-permeable membrane.

From the definitions above, although both involve net movement, it can be said that:

- While diffusion involves the movement of particles, osmosis involves the moment of water molecules.

Home

- While osmosis requires a semi-permeable membrane, diffusion does not.

Based on the differences above, diffusion is not the opposite of osmosis.

End of lesson

Home

NB:

- You **can go back to study the content until you can answer the questions.**

- **You can also go back to the content to restudy whatever you seem to have forgotten until everything is wholly absorbed.**

Home

Double click the top bar to EXIT and END lesson