UNIVERSITY OF EDUCATION, WINNEBA

THE ROLE OF CUES IN IMPROVING STUDENTS‟ LEARNING OF PHYSICS: A CASE STUDY OF FORM ONE STUDENTS OF ST. PETER‟S SENIOR HIGH SCHOOL

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MARCH, 2015

DECLARATION

Student's Declaration

I, CHRISTOPHER SELOM DZORKPATA, declare that this Dissertation, with the exception of quotations and references contained in published works which all have been identified and acknowledged, is entirely my own original work and it has not been submitted, either in part or whole, to any institution any where for any academic purpose.

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Christopher Selom Dzorkpata Date

Supervisor's Declaration

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

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Professor Mawuadem Koku Amedeker Date

(Supervisor)

ACKNOWLEDGEMENT

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I am grateful to Michael, my brother, for such sustained, inspiring academic discourse. It has been an evergreen source of energy for this exercise.

DEDICATION

I dedicate this work to Aku and her unborn child; they are fully aware that this is not even the beginning. And to my teachers, for making teaching for me, such an attraction. To all my teachers.

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ABSTRACT

This study investigated the role of cues in improving students" learning of physics. The study sought to observe students" reaction towards the use of cues in teaching by the teacher. The performance of the students was monitored during the use of the cues. An action – research method was adopted in this study to gather data. During the intervention, cues such as visual, positional, verbal and accessibility cues were adopted to teach the students. These cues were used to teach Form 1students of St. Peter"s Senior High School who were about 60 in the Kwahu East District of the Eastern Region. The main instrument used in this study was observation. However, informal interviews were conducted among the students prior to the intervention. The findings of this study were that students" performance in physics improved significantly. Furthermore, classroom discourse also saw an improvement with students asking a lot of questions during the lessons. The results of the study revealed that about 85% of students get a conceptual understanding of physics when cues are used to teach them.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter serves as the introduction to the dissertation and it caters for the following elements of the study: background of the study, statement of the problem, purpose of the study, research questions, significance of the study, delimitation of the study, limitation of the study, and the organization of the rest of the study.

1.1 Background of the study

In order for physics teachers to provide an environment that facilitates learning in the classroom, an understanding of the factors that are most influential in teaching is required. Although survey data suggest that learners consider effective teaching to be of high priority, how the knowledge is imparted is complex. Besides, how effective the teaching of physics is has also become matter of great concern since the knowledge of physics by students is relevant to national development. Surveys conducted suggest that students perform averagely in physics as a result of the perception that it is difficult and teachers on the other hand do not use the appropriate teaching strategies to arouse students‟ interest in physics. That is, the shortcomings in the teaching and learning of physics have come to light. Because the standard of physics literacy is generally average, it is imaginable that such a system will not be able to turn out enough learners who qualify to enrol universities to follow further physics studies.

A number of factors have been reported pertaining to the poor methods of teaching physics. These include lack of instructional materials, inadequate communication ability of pupils and teachers in the language of instruction, difficulties experienced by teachers to manage activities in classrooms, the lack of professional leadership, pressure to complete examination-driven syllabi, heavy teaching load as well as overcrowded classrooms.

St. Peter‟s Senior High School located in the Eastern region of Ghana, which is the focus of this study has developed and acquired an enviable reputation in the country as a First Class institution in the country. Now it is one of the best Senior High Schools in Ghana with emphasis on science. However, in spite of the excellent performance in science, attaining 100% in the performance of physics has been a problem compared to other science subjects.

Learning is enhanced when learners are self-regulating, actively engage in setting goals, select strategies for achieving goals and monitor their progress toward these goals. Self-regulation hinges on learners being able to access and interpret information that indicates how their present state relates to their learning goals. Teachers on the other hand are supposed to provide this learning environment.

It is in this light that the researcher is adopting a new teaching strategy that will enhance students‟ learning of physics. This is because physics is a key area of knowledge and competence for the development of an individual, and the social and economic development of Ghana in a globalising world. Over the years governments have emphasized the centrality of science (physics) as part of the human development strategy for the country. Performance in this area is one of the indicators of the health of the Ghana educational system. It makes an important contribution to the economy and has been a contributor to inequalities of access and income.

Physics teachers have been under more strain than teachers in other subjects in St. Peter‟s Senior High School because it is generally viewed as a more practical subject, and the teaching thereof is complicated by the fact that the school has large classes and few resources to teach physics. As a consequence of the lack of effective classroom practices and related theoretical debates, many new approaches to professional development have begun to emerge.

In this study, the researcher focuses on experiences perceived by teachers as having been influential in student‟s learning and the explore the constituents and characteristics of these experiences in order to develop a better understanding of the conditions required for meaningful teaching and learning to occur. In this regard, the researcher intends to use cues such as gestural, visual, physical, environmental, and positional cues will be adopted as a new teaching strategy for two weeks to find out how it affects students‟ learning of physics. Although cues are widely accepted by educators as a valuable facilitator of learning, its acceptance and uptake among learners are neither straightforward nor assured. In circumstances in which cues are either not valued or outright rejected learning is presumably shaped by other influences.

Teachers present students with many sources of information about what should be learned and they (students) must make decisions about which of this information requires their attention. Hence, there is a need to better understand the process by which learners sort, interpret and integrate information as they learn. Gaining this understanding will require not only an appreciation of the sources of information, both external and internal to which learners might attend, but also of the process by which these sources of information are weighed, valued and judged. The researcher believes that this will go a long way to develop the students" interest in physics.

1.2 Statement of the Problem

Teaching in Ghana today has been reduced to giving of lecture notes to students to learn and produce during examinations. Teaching of physics in this respect does not provide students with the requisite skills in physics. Besides, the teaching of physics goes beyond giving of notes to students. Physics is a practical subject which requires to teachers to take students through a lot of experiments and relate whatever they teach to the environment in the form of pictorial diagrams and videos of some phenomena. This will help students to get a better understanding of whatever is being taught in the classroom but teachers of today do not apply this strategy. This research therefore proposes to use a new teaching strategy which is the usage of cues such as gestural, visual, physical, feedback and positional cues as a way of improving student"s learning of physics.

1.3 Purpose of the Study

The purpose of this study is to use cues to impart the knowledge of physics to students of Peter"s Senior High School which will eventually help students to understand and apply the concepts of physics.

1.4 Objectives of the study

The objectives of the study are as follows:

a) To enable students use the appropriate scientific terms in explaining scientific phenomena through the use of cues

b) To ensure that students respond to questions posed to them within the shortest possible time through the use of cues

c) To improve students‟ learning of physics the use of cues

d) To develop the interest level of students as far as physics is concerned by adopting the use of cues

e) To lead students to give right answers to questions posed to them through the use of cues

1.5 Research Questions

1) What are some of the appropriate scientific terms students can use in explaining scientific phenomena?

2) How long does it take students to respond to questions posed to them in the classroom?

3) What is the impact of cues on students when used to teach physics?

4) What is the perception of students towards the use of cues in teaching physics?

5) What is quality of answers students give to questions posed to them when cues are used to teach physics?

6) What effective teaching strategies can be adopted to make the physics classroom lively?

1.6 Significance of the Study

Firstly, from the reviews made from related studies elsewhere, it can be discerned that so far emphasis has not particularly been on how to enhance students‟ learning of physics as a subject but on science in general. It is in this regard that the current study is unique. Again, the study will heighten the awareness of the gravity of the problem, so that more efforts will be made by physics teachers to look closely at students‟ activeness in class and device new teaching strategies help improve students‟ learning of physics. Lastly, the research will contribute to knowledge, as it will provide and describe myriads of teaching methods.

1.7 Delimitation of the study

It is advisable to say what is not intended with the research. This helps the researcher to apply his strategies to the problem statement and not waste time on matters that are not directly associated with the problem. With this in mind, this study will confine itself within the Ghanaian context, but will adopt a comparative dimension. Although physics is a challenging subject on the whole, the study will focus on form one students only.

Using cues to teach will improve their learning of physics and prepare them for the higher classes. Time constraints within the confines of this study will not allow for the exploration of information that does not fall within the ambit of this study, but such information will form the basis for further study.

1.8 Limitation of the Study

The intention of this study was for it to cover a greater number of students in the school. It would even be ideal if it involved other schools in the locality in order to compare findings. However, considering the short duration of the study and the time constraints, it will be a daunting task to go beyond the current limits of this study.

1.9 Organization of the Report

The study is organized into five distinct chapters with each chapter dealing with a separate aspect of the study. Chapter one discusses the introduction to the dissertation by looking at the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, and significance of the study, delimitation of the study, limitations of the study and organization of the rest of the study. Chapter two deals with the review of related literature. Chapter three concentrates on the methodology for the study. The next chapter which is chapter four is on results and discussions. Finally, chapter five is on the summary, conclusions, and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter contains the review of related literature on the role of cues in improving students‟ learning of physics. Principally, the review would bring out what education experts have said about how the use of cues influences students‟ learning of physics. In the interest of clarity, the review would be organized under some appropriate headings.

2.1 The Concept of Cues

According to the researcher, cues are expressions that provide a lead for students to the right answers as far as teaching in the classroom is concerned. According to Cangelosi (1988), a cue is a signal that stimulates a student to exhibit a previously learned voluntary pattern. According to him, cues also referred to as prompts are interventions which stop disruptive behavior before its starts by drawing attention away from inappropriate behavior and redirecting attention to appropriate behavior. They consist of words, phrase, or sentence that describes a particular aspect of a concept or skill. They come in various forms including gestural, visual, physical, environmental, feedback and positional cues. A teacher‟s overall instructional effectiveness depends heavily on how that teacher uses instructional cues (Landin, 1994). While cues most often focus on motor skill development in education, they may also target strategy, character development or any other aspect of lessons teachers deem appropriate. A growing body of research (Landin, 1994; Magill & Rink, 1993) suggests that cues enhance learning by improving students‟ attention, comprehension and retention. Cues enhance the attention or focus of learners by restricting what they need to think about. Since learners‟ capacity for attention is limited, it is play an important role in directing students‟ attention towards the most relevant information, and way from less relevant information. As Buchanan and Briggs (1998) put it, "While having more than one cue for the same is useful, be careful not to confuse a student by bombarding him or her with an endless variety of hints" (p.17).

In addition to helping students attend to ideas in a lesson, cues help students comprehend ideas. Naturally, students understand concepts better when teachers communicate them clearly and developmentally. Clarity depends, in part, on using the same terms consistently. Developmental cues result from focusing on (a) process elements before product elements, and (b) basic process elements before advanced process elements (Rink, 1993). Focusing too much on product elements, such as distance and accuracy, directs learner to focus away from understanding how to answer a given question. After communicating cues clearly, teachers are encouraged to incorporate the same ideas as part of the feedback process (Landin, 1994). In this way carefully chosen cues help teachers target their feedback throughout a lesson and unit. Knapp and Hall (2006) define five functions of non – verbal cues: Regulating the flow of conversation, monitoring feedback, reflecting cognitive activity, expressing emotion, and communicating the nature of interpersonal relationship. While understanding ideas is important, it would serve little purpose if students are unable to retain the information for future application. Retention is especially enhanced when cues connect new ideas to previously learned ideas in some way (Magill, 1993). Communication, when done properly, is a two-way interactional process (Suinn, 2006). Radford (1990) declares that effective communication is critical in the classroom environment. Miller (1988) states knowledge is transmitted through effective communication (cues) and nurtured by skilfully sending and receiving message. Through the interpretation of our students‟ non-verbal cues, this seemingly one-way communication can become more interactive, two-way process. Students‟ ability and comfort with processing instruction can be interpreted from their non-verbal cues, which, in turn allows the teacher to advance the discussion based on the type of observed cues.

Angelo and Cross (1993) state that through the use of cues in the classroom, teachers can learn much about how students learn and, more specifically, who students respond to particular teaching approaches. The non-verbal cues that students provide in return are critically important, real-time feedback that influences our subsequent communication (Suinn, 2006) and allows teachers to alter our course of action if needed (Davis, 2009; Neill & Caswell, 1993). Webb, Diana, Diana, Luft, Brooks, and Brennan (1997) state that from observation and interpretation of students‟ gestural cues, the perceptive teacher can decide whether there is a need to check for comprehension, provide more or a different kind of instruction, or assign more practice. Thus, teachers can use classroom observations of non – verbal cues to refocus their teaching to help students make their learning more efficient and more effective (Angelo & Cross, 1993).

2.2 The Effectiveness of Cues as a Teaching Strategy

In order to begin this investigation, it is first helpful to provide a review of the usage of cues in teaching and what has been reported about the development and impact of this process on teacher and student interaction. Comadena, Hung, and Simonds (2007) provide a review of the impact of cues on students which suggests that they have a direct impact on both the psychological attachment of the student to the teacher and the ability of the teacher to connect with the student. This connection can have marked implications for the development of student in terms of overall academic performance. Through the use of cues, teachers are able to control interactions, elicit the attention of the students and show an interest in the information being delivered to the students (Richmond & McCroskey, 2000).

Mackay (2006) further examines the development and use of cues in the classroom. As reported by the author, students often respond to cues used by the teacher. Specifically, this author makes the following observations: The mood and tenor for the day or lesson is established in the first few minutes. At the outset of every class, students and teacher both instinctively assess how they should act and respond to each other. A teacher‟s facial expression, eyes, voice, movement and gesture all convey confidence and control. As students become familiar with the teacher‟s ways their responses don‟t change unless the teacher gives due cause. In this context, he asserts that the cues used by teachers can have a powerful influence over the class. Changes in the use of cues can garner the attention of students, especially if this change occurs after consistent patterns of communication with cues which has been established over time.

Researchers examining the impact of cues on the development of the classroom have also reported that the impacts of cues have different impacts depending on the situational needs which arise in the classroom. Sime (2006) notes that there are three areas for classroom development which are impacted by the teacher‟s use of cues. Reviewing data regarding the use of cues by teachers, Sime (2006) argues that teacher‟s use of cues reinforce classroom processes in three specific areas. First, cues can be used to reinforce cognitive learning. Secondly, cues reinforce emotional connections between the student and the teacher. Finally, cues set an organisation tone for the classroom.

Liu (2001) also notes the role of cues in the classroom. According to him, cues in the classroom serve as number of specific purposes including: "expression emotions, conveying interpersonal attitudes, presenting personality, and amplifying verbal communication" (p.30). Further, the author reports that research regarding the development of cues in the physics classroom has demonstrated that there are five component parts to this process. These include: "paralanguage, facial expression, eye contact and visual behaviour, gesture and body movement, and space" (p.30). Liu asserts that each of these dimensions functions differently in the classroom depending on the context of the classroom environment and the specific subject that is being reviewed.

Additionally, Houser and Frymier (2009) note the role of cues in the development of student empowerment and achievement. Thus, cues make learners focus on relevant materials of study thereby leading them to the right answers. To this end, students always achieve higher scores in their academic performance. According to these authors, the manner in which a teacher responds to a student during an interaction will be reflected through the specific type of cues used. Teachers whose cue patterns are congruent and reinforcing will be able to provide students with a clear sense of confidence in their actions. When there is lack of congruity in the use of cues however, challenges arise creating a high degree of uncertainty for the student. This can impact the student‟s confidence level and reduce the overall sense of accomplishment established through verbal communication tactics. In this regard, the research provided by Houser and Frymier (2009) demonstrates the importance of cues in student development. It also reinforces the need for congruity in the use of cues by the teacher.

Students subsequently use these cues to form their beliefs about how their teacher cares about them and is open to out of class interactions. Not surprisingly, these beliefs influence the probability that the student will initiate contact with the teacher and may help explain why some teachers report frequent interactions with students while other do not. Accessibility has both a physical and psychological dimension. Physically it refers to the tangible availability of the teacher outside of class and the ease or difficulty students have when try to reach them (Granitz, Koernig & Harich, 2009). Psychologically it refers to the teacher‟s attitudes, beliefs and values regarding personally interacting with students and their receptivity to guidance to students or talking with them about questions or concerns outside of the classroom (Faranda & Clark, 2004; Gaglio, Nelson, & King, 2006; Wilson, Woods, & Gaff, 1974).

By implication accessibility goes beyond delivering technical information to students and includes forming a positive personal or social connection with students (Gall, Knight, Carlson & Sullivan, 2003; Vesilind, 2001).

In studying the effects of cues on troubleshooting problem solving, Mayer and Gallini (1990) found that providing the novice troubleshooters with a complete model that contained a descriptive and conceptual illustration (visual cues) of a bicycle tire pump system generated twice as many solutions to the problem than the novice troubleshooter who were provided with an incomplete model of the pump system. Moreover, the number of solutions generated by the novice troubleshooters who were provided with the conceptual model of the pump system was approximately equal to the expert troubleshooters. Similar findings were also obtained in Gentner"s (1983) study, in which they reported that the students performed better on solving battery problems than resistor problems when they were given a conceptual model that illustrated an electrical circuit using water flow as an analogy. Conversely, the students performed better at solving resistor problems than battery problems when they were presented with a conceptual model that made an analogical connection between an electrical circuit and a moving crowd.

Hong and O"neil (1992) demonstrated that students who were presented with diagrams that depicted underlying conceptual statistical conceptions outperformed students who received no conceptual diagrams of instructions. It is clear that cues play a critical role underlying students" abilities in problem solving. According to Grotzer (2000), cues equip students with the capability to develop explanatory knowledge for their own understanding about the physical world.

As an instructional tool for teaching and learning physics concepts, cues can help students understand the concepts by establishing their mental models that depict the covariational causal relationships between the cause and effect in the concepts under study. However, one drawback of cues in assisting students‟ study of physics concepts is that it only allows the students to see the covariational pattern of the cause and effect, but provides no explanation for how and why the causal relationships occur. For students to conceptually understand physics concepts, the omission of chances for the students to appreciate the underlying mechanism of the causality of the concepts can be a deficiency in instruction (Jonnasen, 1999).

According to Howard and Matheson (1989), the use of visual cues in the classroom is simple yet powerful visual display tool for depicting correct relationships among the variables in a complex phenomenon. According to them, they are especially useful for presenting a causal reasoning process because they offer a set of comprehensive directional influential relations indicators to enable students to construct a problem space causally and conceptually. Also, the conciseness of cues makes them an effective communication tool for conveying what the teacher wants to put across (Gotzer, 2000). According to him student‟s conceptual understanding could be enhanced by advancing the sophistication of their causal reasoning models. Thus, visual cues could be appropriate scaffolding means to facilitate the development of students‟ conceptual understanding by guiding them in practicing expert-like causal reasoning processes. With solid conceptual understanding of physics concepts, near and far transfer of the knowledge will be more likely to occur. As a result, the students will be able to solve physics related problems at computational, conceptual, and real life levels.

Perkins and Grotzer (2000) argued that students have to epistemically move beyond the simplified causal modelling reasoning habit. To understand complex phenomena conceptually, teachers have to encourage students to deal with the causal complexity, including different causal relations and interaction such as bidirectional of feedback loop. In cues, the key variables are identified, including the cause(s), the effect, and/or the intermediate variables.

The purpose of using cues in the classroom to teach physics is to deal with complex phenomena. It helps students visualise comprehensive structure of the phenomenon system, as well as enable them to study one part of the representation of the phenomenon without overlooking other parts of the system (Shapiro, Van Den Broek, & Fletcher, 1995). To assist students during a writing process, Scardamalia, Bereiter, and Steinchach (1984) offered students cues to stimulate their thinking about the concept of physics. These cues took the form of introductory courses and were grouped according to their relevance to the scientific world.

2.3 Teaching methodologies in the classroom

Teaching methodology refers to the manner in which a teacher manages instruction and the classroom environment. The changing face of teaching has moved away from didactism to learning facilitation and with this is the need for teachers to play different roles and use new teaching techniques in the classroom (Griffin & Jarvis, 2002). They propounded three main styles of teaching; didactic, Socratic and facilitative. The diversity of styles provides a degree of flexibility that allows one to alter the task of teaching whether it is teacher-centred or student-centred. Jarvis (2002) views teaching as both an art and a science.

The lecture method is probably the most frequently employed teaching technique despite all the criticisms that have been levelled against it (Jarvis, 1983). It is an economical means of transmitting factual information to a large classroom, although there is no guarantee that effective learning will result (Walkin, 2000). The didactic approach to teaching primarily involves lecturing and is essentially teacher-centred (Entwistile, 1997). Fry, Keterridge and Marshall (2003) reminds us that although the lecture remains a major method of teaching in the classroom, and is still recognised “as a useful teaching tool” as it can provide a framework of ideas and theories but it needs to be complemented by interaction and student-oriented strategies due to attention span and lack of participation.

Halloung and Hestenes (1985) reported that the traditional lecture format in physics instruction had little impact on students in improvement of their scientific physics concepts. By assessing four groups of students who took senior high school physics (taught by four different teachers), gains on test scores from pre-test and post-test were far from desirable (13%, 13%, 13%, and 11%; 15%, 15%, 18% and 20% respectively). Halloun and Hestenes suggested that the considerably small gain in physics basic conceptual knowledge made by students after having received formal physics instruction implied that the students continued to employ their preconceptions/misconceptions about physical phenomena throughout the courses. The traditional physics instruction did not function as most educators would hope, in that it did not help students reconstruct their preconceptions about physics into scientific conceptual understanding of physics concepts. Maloney, O‟ Kuma, Hieggelke and Heuvelen‟s (2001) assessment of college students in their conceptual knowledge of electricity and magnetism resulted in similar conclusions.

Teaching is "no longer seen as imparting knowledge and doing things to the student, but is redefined as facilitation of self-directed learning" (Tight, 1996). In an attempt to alter this position, the teacher can use problem-solving techniques and vicarious learning strategies to encourage students to articulate and theorize what they know already in relation to the meaning of their experiences and their interpretation (Preece & Griffin, 2002). The facilitative approach to teaching teases out previous learning and helps students „make sense‟ of experiences in relation to real world events (Gregory, 2002).

A survey conducted on the performance of form one students of St. Peter‟s Senior High School in physics revealed that, after receiving formal physics instruction (lecture method), the students still could not correctly answer more than 50% of the questions on the test. These results suggest inadequacy of the effect of traditional physics instruction improving conceptual understanding of basic physics concepts. One might argue that physics is a difficult subject for average students because of the nature of its abstraction. The results of the studies of highly competent students showed that they had similar difficulties with physics concepts as average students.

The Socratic method of teaching also emphasises student-centredness and strongly opposes didacticism. Brownhill (2002) illustrates how teachers can use either authoritarian or non-authoritarian Socratic teaching positions to enhance students to learn independently and become critical thinkers. Teachers provide the initial theoretical positions and introduce the associated inconsistencies and attributes in an attempt to raise awareness in students, initiate reflection and ponder on the key concepts. Both autocratic and non-autocratic teaching approaches equally enhance the ability of students to conceptualise and reflect on positions (Brownhill, 2002).

Peters (1982) reported that in one of the exercises that were used to assess conceptual understanding of physics content, only 10% of the students were able to correctly represent the path of a ball with an accurate graph representation in an exercise on motion in two dimensions. Even when given the second chance, only 30% of the students were able to represent the motion correctly while the responses of the remaining 70% of the students still contained numerous errors.

Scaffolding is learning process designed by teachers to promote deeper level of learning. It is the support given during learning process which is tailored to the needs of the student with the intention of helping the student achieve his/her aim (Sawyer, 2006). According to Barbas and Psillos (1997), scaffolding students is another method of teaching that helps students to construct conceptual understanding of physics concepts by presenting problem representations that illustrate the core causal relationships of the concepts which further helps them establish the conceptual framework, conceptualise the problem and create the mental model for that specific problem. According to them, constructing problem representations is a process of conceptualisation because problems are represented as a concise simplified system model that connects the variables in the problem directly to the corresponding conceptual components within the domain knowledge. Problem representations show only the core inter-causal relationships between the variables and filter out the insignificant variables and relations that may cloud the students‟ insight of the core concept.

Jonassen (1999) argued that a conceptual understanding of how the problem conceptually interconnects to the domain knowledge is a necessity if students are to fully understand the physics problems and be able to transfer the problem – solving skills later on in their personal or professional lives. In order for students to acknowledge and understand a specific topic, teachers dissect the topic into sub-components so that students can visualize the importance and relevance of each component (Laurillard, 1997).

Ploetzner and Spada (1993) claim that qualitative reasoning facilitates quantitative problem solving. Thus, to help students understand physics concepts conceptually, Grotzer‟s (2000) suggestion of explicit instruction of causality is exactly at the heart of the notion of explicitly guiding students to comprehend the qualitative representation of the physics concept under study.

Hake (1987) compared using the qualitative approach and the conventional approach to problem solving in the concepts of motion in a six – week non calculus – based introductory course. The qualitative approach employed in the study focused on initial qualitative analysis, vector diagramming, contrasting Newtonian concepts with students‟ non – Newtonian ideas on motion, posing qualitative, conceptually oriented questions, and demonstrations. The data collected from the experiment showed that the experimental group gained 20% more than the conventional lecture group from pre – test to post – test on the mechanics test. The results suggest that the instruction designed to engage students in the qualitative approached helped promote their conceptual understanding of Newtonian mechanics.

In teaching highly abstract, complex physics concepts, Kalkanis, Hadzidaki, and Stavrou (2003) suggested that to overcome the problem of persistence of misconceptions about quantum mechanics, instructing students by qualitatively illustrating the world view of quantum mechanics, instructing students by qualitatively illustrating the world view of quantum mechanics may be a more effective way of remedying the problem. Van Someren and Tabbers (1998) made a similar assertion that teaching students how to conduct qualitative analysis and reasoning about the concepts studied before proceeding to quantitative representations of the concepts and problems will enhance their performance in problem solving.

Jonassen (2000) proposed that usage of simulations by teachers in the physics classroom facilitate students in their learning of concepts by providing opportunities to interact and experiment with the environment in order to construct a mental model that represents the patterns of critical causal relations among the variables of the phenomenon. After several trials, Champagne, Klopfer, and Anderson (1980) suggested that using computer – based graphic simulations is a promising instructional intervention for guiding and encouraging the students engaging in experimental types of learning activities. As a result of interacting with the variables in the simulation, the students may be able to distinguish the different behaviours of objects in an Aristotelian physical world and in a frictionless Newtonian world.

Kochhar (2000) stated; a problem, an issue, a situation in which there is difference of opinion, is suitable for discussion method of teaching. According to him, students rated group discussion as one of the best method of teaching giving reasons that; it has more participation of students, the learning is more effective, the students do not have to rely on rote learning, every student give their opinion and this method develops creativity among students. Additionally Kochhar (2000) stated that teachers who give regular assignments to students help in their organisation of knowledge, assimilation of facts and better preparation of examinations. It emphasizes on individual pupil work and the method helps both the teaching the learning processes.

Cooperative learning which is another effective teaching method refers to any pairing of between two and six students for learning (Braundy, 1997). According to him, cooperative environments generally foster greater learning and retention than larger modes of instruction (e.g., lectures). Cooperative groups can be formal study groups, informal discussion groups or task-oriented groups. Cooperation, creativity, responsibility, constructive feedback, conflict resolution skills and problem-solving skills are typically developed and necessary in small group environments. Students get to informally address their assignments. The teacher"s task is to foster a positive emotional environment where group members experience a sense of responsibility and interdependence. Cooperative learning provides an environment where those who may be reluctant to present their ideas in a large group may find some comfort and confidence (Braundy, 1997).

Wilhem (2007) also suggested inquiry based learning as a powerful alternative in the teaching and learning process. According to him, everything taught in an inquiry unit, including attitudes, strategies and concepts, is in the service of investigation the question, and understanding and doing things related to the question. This requires students to be active participants in disciplinary conversations and in their learning (Wilhem, 2007). According to Newman (1996), studies have shown a positive impact on learning when students participate in lessons that require them to construct and organise knowledge, consider alternatives, engage in detailed research, inquiry, writing, and analysis, and to communicate effectively to audiences.

Project-based learning involves completing complex tasks that typically results in a realistic product, event, or presentation to an audience. Thomas (2000) identifies five key components of effective project-based learning. It is: central to the curriculum, organised around driving questions that lead students to encounter central concepts or principles, focused on a constructive investigation that involves inquiry and knowledge building, student-driven and authentic, focusing on problems that occur in the real world and that people care about.

Some theorists have emphasised the value of problem – based learning as another teaching strategy where the content is presented indirectly through a rich simulation of a real – world, problem – centred environment (Hmelo – Silver, 2004; Lee, Shen & Tsai, 2008). Evenson and Hmelo (2000) state problem based learning as one of many contextualised approaches that much of the learning and teaching is anchored in concrete problems. In spite of many literatures on problem based learning, its core model is based on the ideas that learning should occur in concrete situations that have a relationship with students" prior knowledge and experiences (Barrows, 1986).

2.4 The attitude and perception of students towards the learning of physics

The experience of low participation in physics among students at varying levels of learning seems to be global as reflected by Nashon (2003) in his study of physics teaching and learning. Research have identified reasons for poor attitude, low enrolment and underachievement in the physics to include ill-equipped laboratories, teacher and gender factors and insufficient funding (Meltzer, 2002; Delphonso, 2003; Danmole & Adeoye, 2004; Alebiosu & Bamiro, 2007). The factor of high mathematical or quantitative demands has been identified specifically for physics (Onwu & Opeke, 1985; Egbugara, 1986; Adepitan, 2004). Iroegbu (1998) asserted that poor numerical aptitude generates lack of confidence in handling numerical problems in physics. Similarly, Meltzer (2002) explained that ability is positively correlated to achievement in physics.

The attitudes formed by students towards any subject will go a long way to decide and determine the student"s choice and achievement in that subject as his or her career choice (Woolnough, Guo, Leite, de Almeida, Ryu, Womg & Young, 1997). Simpson and Oliver (1990) identified factors of teachers" attitude, teaching methods and personality, attitude of parents and peers, nature and perception of the subject among components influencing students" attitude towards the physics course.

The above explains that teachers are very important determinants of students" enrolment, achievement and essentially, attitude towards the subject. The teacher is a consultant, guide, mentor, and moderator (Krejster, 2004). Teachers" use of innovative instructional strategy stands a higher chance of positively influencing the attitude of the learner to the subject. Negative attitude towards a certain subject makes learning or future – learning difficult (Guzel, 2004), hence when students are positively inclined towards a subject they tend to do well in that subject. Developing students‟ attitude towards science is the most important purpose of science education and apart from students, teachers‟ attitude towards science and science teaching is also crucial (Guzel, 2004). Adepitan (2004) remarked that the problem of understanding concepts in physics is not commonly among students, it is also peculiar to teachers.

A review of literature reveals that many science teachers have recognised that students‟ view about the science course is different from scientific one. Craker (2006) suggested that prior knowledge has a great effect on student‟s knowledge of scientific concepts. Festingel‟s cognitive theory states that individuals or students seek some degree of consonance between their attitudes and action. Bajah (1998) explained that the position and negative attitudes of students themselves have been suggested as a contributing factor to misconceptions of physics. George (2000) further explained that inadequacies of furniture fitting and equipment in the physics classrooms and laboratories where teaching and learning takes might contribute to misconceptions and alternative conceptions. Physics is considered as the most problematic area within the realm of science, and it traditionally attracts fewer students than biology and chemistry (Rivard & Straw, 2000). Physics is perceived as a difficult course for students from the senior high school level to the university level. The measurement of students‟ attitudes towards physics should take into account their attitude towards the learning environment (Crawley & Black, 1992).

Research has made us known that the attitude towards science change with exposure to science, but the direction of change may be related to the quality of that exposure, the learning environment and the teaching method (Craker, 2006). If students have negative attitudes towards science, they also do not like physics course and physics teachers. Based on this premise, numerous studies have been conducted to determine the factors that affect the students‟ attitudes in physics. Some of the basic factors are teaching – learning approaches, the type of science course taken, methods of studying, intelligence, gender, motivation, physics teachers and their attitudes, students‟ attitudes to the physics course, self adequacy, cognitive style of students, career interest, socio economic levels, influence of parents, and so on (Dieck, 1997; Halladyna & Shanghnessy, 1982; Mattern & Schau, 2002; Normah and Salleh, 2006; Rivard and Straw, 2000).

Whitfield (1980) argued that the rejection of science by students was accounted for by the perception that is was a difficult subject but his findings, based on data collected in the 1970s , now lack significance because of the considerable changes that have occurred in the science curriculum (in particular, the move to balanced or integrated science) since his study was conducted. The work of Osborne and Collins (2000) would suggest that, for many, the contemporary curriculum may suffer from the obverse problem with too much emphasis on undemanding activities such as recall, copying and lack of intellectual challenge.

2.5 Importance of teaching methodologies in the teaching and learning process

Research has shown that conventional teaching and traditional teaching methods have negative effects on the ability of learning physics for the majority of students (Erdemir, 2004; Halloun & Hestenes, 1987; Van Heuvelen, 1991). Conclusions from the research show that in order to increase level of attitude and success in physics education, new teaching methods and technology need to be implemented into physics education (Adesoji, 2008; Gonen & Basaran, 2008; Reid & Skryabina, 2002). In this regard, Gok and Silay (2008) worked on the effects of directive and non – directive problem – solving on attitudes and achievement of student in a developmental science course; the result was that attitude becomes more positive after instruction. Therefore, it is reasonable to claim that the usage of problem – solving teaching strategy is more useful than conventional methods of physics learning. This is because by solving problems, students need to think and make decisions using appropriate strategies. Students" success in achieving their goals will encourage them to develop positive attitudes towards physics and other problem – solving activities (Patton, Cronin, Basset & Koppel, 1997).

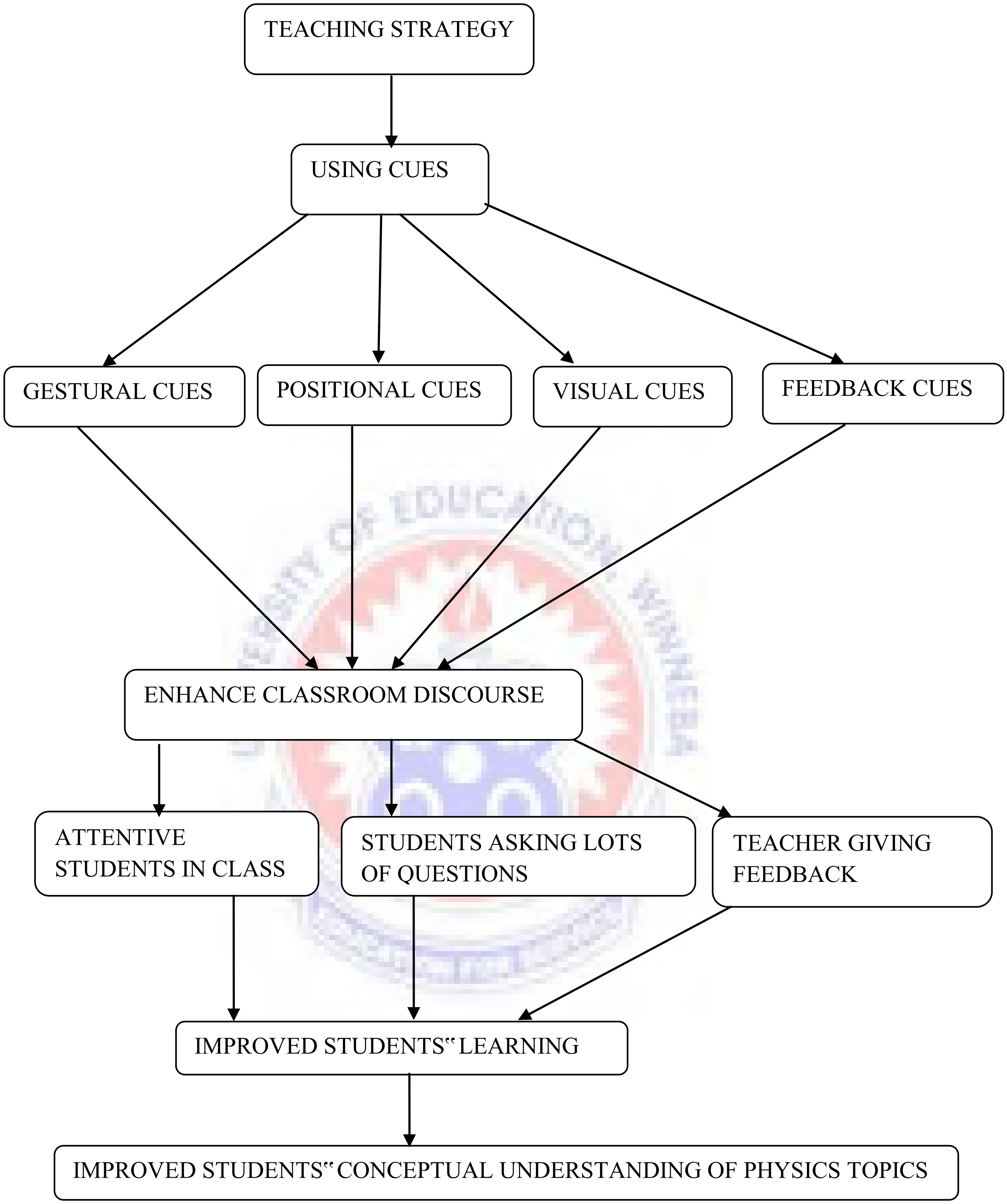
Invariably, instructional strategy and teaching method are important determinants of attitude students to physics (Orji, 1998; Meltzer, 2002 and Alebiosu, 2006). According to them, concept mapping as a teaching method relates with the meaningful learning theory whose advantage lies on the fact that learning new knowledge is dependent on what is already known. They uphold that new knowledge gains meaning when it can be largely related to a framework of existing knowledge rather than being processed and stored in isolation. By using concept maps, the learning process becomes active rather than passive. Johnson (undated) alluded that concept maps allow for handy ways to take notes during lectures, assist in planning students" studies, help students to refine creative and critical thinking.

Chang, Sung and Lee (2003) found that inquiry based method of teaching facilitates students" knowledge of elicitation and exchange of inner thinking. Plowright and Watkins (2004) found that problem based learning (PBL) teaching approach is better at fostering the development of knowledge and skills within a professional discipline, while inquiry based learning (IBL) approach divides the development of knowledge and skill into discrete units and imposes an assessment regimen that provides little opportunity for make connections between different subject areas. Accordingly, research has shown that student performance and the transfer of newly acquired skills are largely affected by the degrees of contextualisation in instruction. It has been found that contextualised teaching methods such as PBS, are most suitable for supporting the process of solving a problem and acquiring knowledge and that an active learning approach such as IBL, most suitable for supporting the acquisition of complex problem – solving strategies

Several studies (Dincer & Gunevsu, 1998; Treagust & Peterson, 1998; Kalayci, 2001; Senocak, 2005) have given the following as the importance of general effective teaching methods in the physics classroom: classes are student – centred instead of being teacher – centred thereby developing students" high level thinking and scientific skills; it allows students both to merge their old knowledge with new knowledge and to develop their judging skills in a specific discipline environment; it enables students to see events multi – dimensionally and with a deeper perspective; it encourages students to learn new materials and concepts when solving problems and also motivates learning for both teachers and students.

2.6 Conceptual framework

In this study the Researcher developed a conceptual framework that uses teaching with the use of cues to improve students" learning of physics.



The framework consists of teaching techniques that could improve students" classroom discourse which would enable them to improve their comprehension in responding to conceptual questions. The framework makes use of cues which could influence students" classroom discourse. Through the use of cues, teachers are able to control interactions, elicit the attention of the students and show an interest in the information being delivered to the students (Richmond & McCroskey, 2000). Sime (2006) said that teacher"s use of cues reinforce classroom processes in three specific areas. First, cues can be used to reinforce cognitive learning. Secondly, cues reinforce emotional connections between the student and the teacher. Finally, cues set an organisation tone for the classroom.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter deals with the procedures followed in this research. It encompasses data collection methods, the subjects and the mode of analysis. Essentially one instrument was used in this research: observation. This is a descriptive research and as such, students" reactions to a particular teaching strategy were observed and described after which a test was conducted for the students. An informal interview was also conducted among the students to out their attitude towards physics classroom. All these feedbacks are geared towards getting an outlook of the role of cues in improving students" learning of physics.

3.2 Research design

According to McMillan and Schumacher (1996), research design refers to the plan used by the researcher to obtain evidence in order to obtain answers to research questions. Takona (2002) adds that research design refers to the principles and procedures underlying systemic inquiry. A research design is a strategic framework for action that serves as a bridge between research questions and the execution or implementation of the research. Research designs are plans that guide the arrangements of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. It is the designed and planned nature of observation (Terre Blanche &Durrheim, 1999).

There are a number of research designs used in any research. Historical research design is one of the designs with the purpose of collecting, verifying, and synthesizing evidence to establish facts that defend or refute a hypothesis in the research. It uses primary sources, secondary sources, and lots of qualitative data sources such as logs, diaries, official records, reports, etc. The limitation is that the sources must be both authentic and valid.

Descriptive research design describes and explains conditions of the present by using many subjects and questionnaires to fully describe a phenomenon. It helps provide answers to the questions of who, what, when, and how associated with a particular research problem; a descriptive study cannot conclusively ascertain answers to why. Descriptive research is used to obtain information concerning the current status of the phenomena and to describe "what exists" with respect to variables or conditions in a situation.

Action research design follows a characteristic cycle whereby initially an exploratory stance is adopted, where an understanding of a problem is developed and plans are made for some form of interventionary strategy. Then the intervention is carried out during which time pertinent observations are collected in various forms. The new interventional strategies are carried out, and the cyclic process repeats, continuing until a sufficient understanding of the problem is achieved (Stake & Robert, 1995).

Correlational research design talks about exploring relationships to make predictions. It uses one set of subjects with two or more variables for each. Causal research design is another type of research design which talks about exploring cause and effects of relationships where causes already exist and cannot be manipulated. It uses what already exists and looks backward to explain why. Exploratory research design is conducted about a research problem when there a few or no earlier studies to refer to. The focus is on gaining insights and familiarity for later investigation or undertaken when problems are in a preliminary stage of investigation.

Experimental research design is another design which is most appropriate in controlled setting such as laboratories. It attempts to explore cause and effects of relationships where causes can be manipulated to produce different kinds of effects. The experimental design specifies an experimental group and a control group. The independent variable is administered to the experimental group and not to the control group, and both groups are measured on the same dependent variable.

A case study design is also an in-depth study of a particular research problem rather than a sweeping statistical survey. This design may be considered as quantitative or qualitative depending on the purpose of the study and the design chosen by the researcher. As is true of other types of qualitative studies, for a case study to be considered as a qualitative study, the research must be interested in the meaning of experiences to the subjects themselves, rather than in generalizing results to other groups of people. Case studies are not used to test hypothesis, but hypotheses may be generated from case studies (Younger, 1985). It is often used to narrow down a very field of research into one or a few easily researchable examples. The case study research design is also useful for testing whether a specific theory and model actually applies in the real world. It is a useful design when not much is known about a phenomenon. This design excels at bringing use to an understanding of a complex issue through detailed contextual analysis of a limited number of events or conditions and their relationships.

Observational design is another research design which draws a conclusion by comparing subjects against a control group, in cases where the research has no control over the experiment. There are two types of observational designs. In direct observations, the research subjects are aware that you are watching them. Unobtrusive measures involve any method studying behaviour where research subjects do not know they are being observed. This design allows useful insight into a phenomenon and avoids the ethical and practical difficulties of setting up a large and cumbersome research project (Atkinson, Paul &Hammersley, 1994)

Sequential research design is that which is carried out in a deliberate, staged approached where one stage will be completed, followed by another, then another, and so on, with the aim that each stage will build upon the previous one until enough data is gathered over an interval of time to test your hypothesis. The sample size is not predetermined. After each sample is analyzed, the researcher can accept the null hypothesis, accept the alternative hypothesis, or select another pool of subjects and conduct the study once again. This means the researcher can obtain a limitless number of subjects before finally making a decision whether to accept the null or alternative hypothesis (Ivankova, 2006). Using a quantitative framework, the sequential design generally utilizes sampling techniques to gather data and applying statistical methods to analyse the data. Using qualitative framework, it generally utilizes samples of individuals or groups of individuals and uses qualitative methods such as interviews or observations, to gather information from each sample (Bovaird, James & Kevin, 2010).

Meta – analysis research design is an analytical methodology designed to systematically evaluate and summarize the results from a number of individuals studies, thereby, increasing the overall sample size and the ability of the research to study effects of interest. The purpose is not to simply summarize existing knowledge but to develop a new understanding of a research problem using synoptic reasoning. The main objectives of this design include analyzing differences in the results among studies and increasing the precision by which effects are estimated (Cooper, Harris, Larry & Jeffrey, 2009).

In this study, an action research design was adopted. This is because the main objective of this study is to improve students‟ learning by adopting new teaching strategies. For this reason, an action research design was used to obtain in – depth information about students‟ learning physics. Informal interviews were also conducted among the students to find out their attitude and perception about the physics course. The Researcher used gestural cues, accessibility cues, feedback cues, visual cues and positional cues as a new teaching strategy in the physics classroom for three weeks. In adopting the new strategy, which is the use of cues to teach, the researcher had to concurrently observe critically, students‟ attitude or participation in the classroom whiles teaching. A test was then conducted thereafter to assess the quality of the answers they gave to the questions posed to them. After all these processes, data was collated and set for analysis. The results of this study will be to recommend effective teaching strategies teachers can adopt to help improve students‟ learning of physics in St Peter‟s Senior High School and schools as a whole.

3.3 Population

According to Best and Kahn (1993), a population is any group of individuals that have one or more characteristics in common that are of interest to the researcher. They proposed two types of population; target population and accessible population. Target population consists of the specific group to whom the researcher plans to generalize the findings of the study. The accessible population is the groups that are convenient for the researcher and representative of the overall target population (Best & Kahn, 2006).

This study seeks to determine the role of cues in improving students" learning of physics. In this study the population for this study was all senior high school physics students in Ghana. Since the population would be too large, a case – study approach was adopted to focus on students of St. Peter"s Senior High School. The respondents in this study were form one students of St. Peter"s Senior High School. The decision to focus on form one students who were about 100 was based on the fact that, having undergone a term in first year in the physics class; it was advisable for an intervention before they got to the upper classes. The Researcher hoped that this intervention will maximize students" interest in the physics class and consequently be able to understand physics concepts and ultimately pass their final exams.

3.4 Sampling and sampling procedure

There are two types of sampling procedures, which are according to McMillan (1996), are probability and non probability sampling. Probability sampling procedures include simple random sampling, systematic sampling, stratified sampling and cluster sampling.

Non probability sampling procedures include convenience sampling, purposive sampling and quota sampling. Probability sampling is a method of sampling in which the subjects are selected randomly in such a way that the researcher knows the probability of selecting each member of the population (McMillan, 1996). In systematic sampling, every nth individual is selected from a list of all individuals in the population, beginning with a randomly selected individual (Fraenkel&Wallen, 2003).

Simple random sampling is one in which each and every member of the population has equal and independent chance of being selected (Fraenkel&Wallen, 2003). Randomization is a carefully controlled process which is used in research to avoid sampling biases; also to ensure that each unit in the population has an equal chance to be included in the sample (Van-Dalen, 1979). Simple random sampling has the advantage of getting representative of the population, it is easy to analyse, interpret results and it is easy to understand. However, it requires numbering each member in the population and larger sampling error exists (McMillan, 1996). In this study, convenience sampling technique was employed. Convenience sampling is a sampling that uses participants who are most conveniently available (Field, 2006). This sampling technique was used because the subjects were closer to the researcher. The sample size for this study was 100 physics students.

3.5 Instruments and instrumentation

Research instruments are measurement tools designed to obtain data on a topic of interest from research subjects. It helps to keep track of what is being observed and how to report it. Some research instruments used in research include observation, interviews, questionnaires, tests, checklists, tally sheets, flow charts, attitude scales and rating scales. Data collection is an indispensable element in conducting research. O"Leary (2004) remarks that collecting credible data is a tough task and it is worth remembering that one method of data collection is not inherently better than the other.

According to Frenkel and Wallen (2003), instrumentation refers to the whole process preparing to collect data. It entails not only the selection or design of the instrument but procedures and conditions under which the instrument will be administered. To McMillan and Schumacher (1972), instrumentation also includes the way changes in the instruments or persons used to collect data might affect the results. For data collection in this study, class observation and activities were used during lessons. However, informal interviews were also conducted among the students to determine their perception of the physics activities used in the lessons.

3.6 The Intervention

The main instrument for this study was observation. It involved the Researcher taking a close scrutiny of a situation involving the research respondents with respect to areas that are relevant to him. The Researcher observed the students for almost a month while he taught physics and varied his approaches through the use of cues. He had the opportunity of meeting with the students twice a week over the period and made very significant observations. During the lesson, the Researcher used these cues to observe student"s reactions in class. In the course of the lesson, various diagrams (visual cues) where shown to students as an illustration of what the teacher was delivering. Where diagrams were not available, the teacher had to use body language or signs (gestural cues) as a representation of what was being taught in class. In the course of the lesson, the teacher intermittently posed questions to students to find out the quality of the answers given. Where wrong answers were given, the Researcher had to re – show the students illustrations that would direct their minds to the right answers (feedback cues). Regularly, the teacher walked through the class (positional cues) to observe critically, students" reactions. All these observations will be described and discussed while the relevant deductions will be made.

3.7 Data collection

Critical observations were made while the teaching and learning process was ongoing and all individual reactions from students noted. Individual responses from the informal interviews conducted were also noted. Additionally, data was collected from the test conducted after teaching and recorded.

3.8 Data analysis

Data analysis is the process of simplifying data in order to make it comprehensive. Therefore in data analysis, any statistical techniques, both descriptive and inferential to be used should be described (Jack & Norman, 2003). This study, being a descriptive survey required descriptive statistics for analysis of the data.

For easy analysis and presentation of data, the cues used during the teaching and learning process was paired with their corresponding reaction and was analysed. All the responses gotten from the informal interview conducted were collated and also analysed. All these results were then summarized as major findings of the study. The discussions will be done according to the major findings identified in the study and used to answer the research questions.

3.9 Choice of physics topic

For a research as this, it was necessary to use a topic that would arouse the interest of students; encourage participation; generate controversy; and stimulate thinking. For this reason, the Researcher settled on Newton"s laws of motion. The topic has direct relation to the environment.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.0 Overview

This chapter deals with the report on the finding of the study by means of an in - depth analysis of empirical findings. It also focuses on the specific themes that emerged during the study. The data obtained from the individual interviews and observations during the intervention have been presented and interpreted. This was followed by appropriate deductions from the data collected. For the purposes of this study, three lessons were allocated for the intervention.

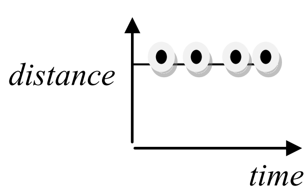
4.1 Lesson 1

Topic: Linear and Non – linear motion

In this lesson students were required to describe scientifically the differences between distance and displacement, speed and velocity. A lot of diagrams were drawn on the board to illustrate these terms (Appendix A). In demonstrating the difference between distance and displacement, two students were asked to come forward; one was asked to walk through the class in specified directions to represent displacement demonstrating the use of gestural cues. The other was asked to move from a particular point to another in a specified direction to illustrate displacement. The class became more interactive when the Researcher explained that in understanding displacement, if one moved from a particular point to another in a specified direction and moves back to that point, there is zero displacement. This took some time for students to digest. For velocity and speed, the motion of two cars was projected on the board (visual cues) with one moving in a specified direction and the other moving in different directions to illustrate velocity and speed respectively. They were also expected to know the meaning of uniform velocity, acceleration and uniform acceleration. Apparently most of the students had some ideas about these scientific terms. It was however discovered by the Researcher that most of the responses students gave in the course of the lesson were not scientific. Some of the responses to questions posed were: velocity is the movement of a car; acceleration is a body in motion; velocity is the speed of car. In this light, efforts were made to give detailed explanations of these terms. For easy understanding of the other terms, the Researcher had to project them on a screen for students to be able to know when a car is accelerating and when it is not accelerating. It was interesting when some students deduced that if a car moves with a constant velocity then it is not accelerating. This ensured full participation of the students during classroom discourse. After the lesson a quiz was conducted to ascertain students‟ understanding. A total of five questions were asked and below are some the questions and their corresponding answers:

CUES: videos related to the questions asked were displayed with a projector whiles students tied to solve the questions. They were also reminded of all the demonstrations carried out during the lesson.

Question 1: Describe the motion of this particle



Students‟ responses:

Student 1: *The particle is at rest*

Student 4: *The particle is not moving*

Expected response: *The particle is at rest*

These responses from the students are improvements compared to the responses before the lesson started.

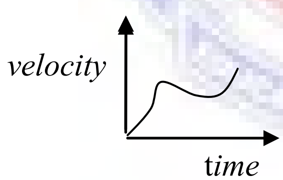
Expected response: *zero*

This was an indication that students were gradually getting the concept of linear motion

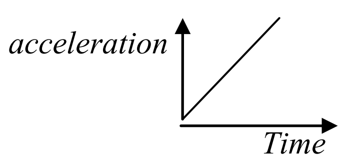
Question 3: Draw a graph to illustrate a car moving a in a non – uniform acceleration.

Students‟ responses:

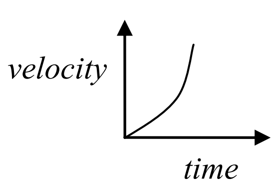
Student 1:



Student 2:



Expected response:



These responses were a clear indication that students" misconceptions were gradually dying out.

Summary of findings 2

Major findings
At the end of this lesson, students were able to • Distinguish between distance and displacement, speed and velocity with practical examples • Interpret and represent the motion of bodies graphically

4.2 Lesson 2

Topic: Graphs of motion

In this lesson students were expected to be able to draw motion graphs for the motion of any particle which would enable them to calculate the total distance travelled by the car. Having been introduced to the topic in the first lesson, the students were expected to produce the graphs motion of particles moving with a uniform acceleration, moving with constant velocity, and decelerating finally with ease. Most of them responded positively when questions were posed to them with few of them having challenges. Enough time was taken to give further explanations where they seemed to be lost. Among some of the questions were:

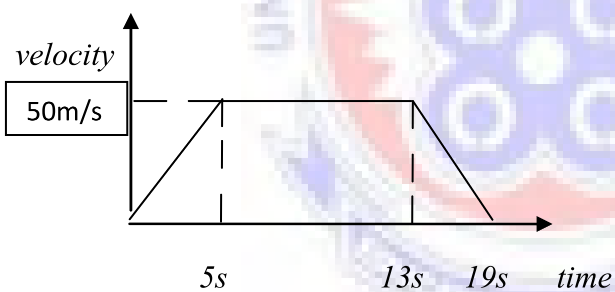
Question 1: A car starts from rest and moves with a uniform acceleration to a velocity of 50m/s for a period of 5s. It then moved with a constant velocity of 50m/s for a time of 8s and finally decelerated uniformly to a stop for further 6 seconds. Draw a velocity – time graph for the motion of the car and calculate the total distance travelled by the car.

Expected response: In this question, students were to first draw the x and y axes indicating on them time and velocity respectively. They will then identify the fact that the body is from rest so the graph will start from the origin. From previous knowledge of constant velocity and deceleration, students would then complete the graph of motion with the time intervals.

CUE: previous calculations were left on the board uncleaned.

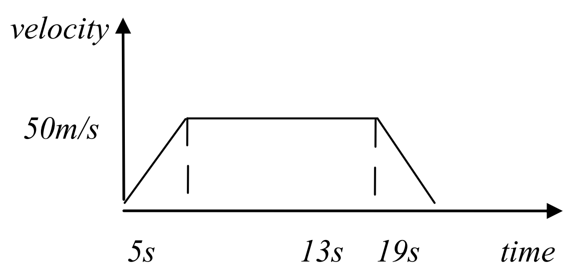
Students" responses:

Student 1:



$distance = \frac{1}{2} x19\, x50 \;\; = 475m$

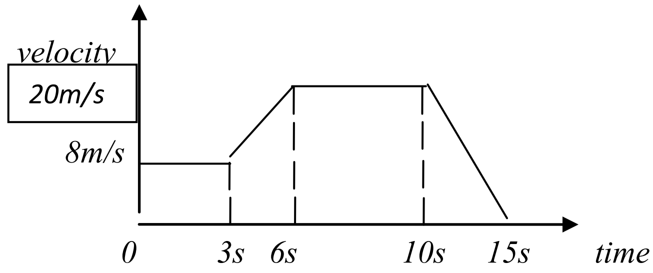
Student 2:



$distance = \frac{1}{2} x19\, x50 \;\; = 475m$

Students were able to answer the questions correctly

Question 2: Interpret the motion of the particle in the graph below



Students" response:

Student 1: *the particle moves with a constant velocity of 8m/s for 3s and then accelerates uniformly to a velocity of 20m/s for a further time of 3s. The particle maintains this velocity for 4s and then retards uniformly to rest in a time of 5s.*

Student 2: *The particle moves with a constant velocity of 8m/s for 3s and then accelerates constantly to a velocity of 20m/s for a further time of 3s. The particle maintains this velocity for 4s and then decelerates uniformly to rest in a time of 5s*

Student 3: *the particle starts from rest and moves with a constant velocity of 8m/s for 3s and then accelerates uniformly to a velocity of 20m/s for a further time of 3s. The particle maintains this velocity for 4s and then retards uniformly to rest in a time of 5s.*

With the exception of student 4, students were able to interpret the motion of the particle correctly. Attempts were however made to correct students who still had difficulty.

Summary of findings 3

Major findings 2
In this lesson about 95% of students being able to • Represent the motion of bodies graphically • Calculate the total distance travelled by a body on a velocity-time graph

4.3 Lesson 3

Topic: Newton‟s equations of motion

This topic was aimed at helping students appreciate what they had learnt. In this lesson students will be able to determine the initial velocity, final velocity, acceleration, time and distance travelled of a car given the necessary parameters. Newton‟s equations of motion were explained in details.

$$V = U + at; \quad s = ut + \frac{1}{2}a\,t^2 \;, V^2 = U^2 + 2aS, \quad S = \frac{(u+v)t}{2}$$

Where v is the final velocity, u is the initial velocity, t is the time taken to cover a distance, a is the acceleration and s is the total distance travelled.

From previous knowledge, students were able to appreciate the fact that for a particle starting from rest, it had an initial velocity of zero. This made the work of the Researcher a little easier. A lot of questions were given to students to try their hands on in order for the Researcher to know whether they understood the topic. Students were cautioned that anytime they were given the questions they had to write the parameters down which would guide them as to the appropriate equation to use (Appendix C). Below are a couple of the questions and the responses from the students.

CUES: they were told not to forget the fact that for a body to accelerate there must be a change in velocity. They were reminded that if a body starts its motion from rest, it has no initially velocity.

Question 1: A body moved with a constant velocity of 20m/s in 4s. Calculate the acceleration of the body.

Students‟ responses:

Student 1: *velocity = 20m/s, time = 4s*

$$a = \frac{v-u}{t} \quad , \quad a = \frac{20-0}{4} = 5m/s^2$$

Student 2: $a = \frac{v-u}{t}$, *since there is no change,* $a = \frac{0}{4} =$ *zero*

Question 2: A car initially at rest moves with a velocity of 10m/s for a time of 2s. Calculate the acceleration of the car.

Students‟ response:

Student 1: *From the question* $u = 0$ $v = 10m/s$ $t = 2s$ $v = u + at$

$$10 = 0 + a \times 2, \quad 10 = 2a, \quad a = 5m/s^2$$

Student 2: From $v = u + at$, $a = \frac{v-u}{t}$, *where* $u = 0$, $v = 10m/s$, $t = 2s$ $a = \frac{10-0}{2}$,

$a = 5m/s^2$

Almost every student was able to solve this question

Question 3: A body initially travelling at 15m/s stops in 3s. If the final velocity of the body is 12m/s, calculate the acceleration of the car.

Students" responses:

Student 1: $v = u + at$, $12 = 15 + a \times 3$, $12 - 15 = 3a$ $-3 = 3a$, $a = -1 m/s^2$

Student 2: $v = u + at$, $12 = 15 + a \times 3$, $12 - 15 = 3a$ $-3 = 3a$, $a = -1 m/s^2$

Student 3: From $v = u + at$, , $a = \frac{v-u}{t}$ $a = \frac{12-15}{3}$, $a = -1 m/s^2$ *but acceleration cannot be negative, therefore* $a = 1 m/s^2$

After this particular question the Researcher could see that students were eager to ask questions. Students did not understand why they were getting negative answers. That was the more reason why student 4 changed his answer to positive though he had a negative answer. The Researcher drew the students" mind to the velocity – time graph where some portion of the graph was declining to illustrate deceleration. Students were now convinced that if there is a reduction in velocity, it would affect the acceleration negatively.

Question 3: A car initially at has a velocity of 5m/s and accelerations uniformly until its velocity change by 28m/s after moving through a distance of 50m. Calculate the acceleration of motion

Students" responses:

Student 1: $v^2 = u^2 + 2aS$, $(28 + 5)^2 = 5^2 + 2 \times a \times 50$, $1089 = 25 + 100a$, $1089 - 25 = 100a$, $1064 = 100a$, $a = 10.64m/s^2$

Student 2: *change in velocity* $= v - u$, $28 = v - 5$, $v = 28+5 = 33m/s$, *from* $v^2 = u^2 + 2aS$, $33^2 = 5^2 + 2 \times a \times 50$, $1089 = 25 + 100a$, $1089 - 25 = 100a$, $1064 = 100a$, $a= 10.64m/s^2$

Student 3: from v = u + at, $a = \frac{v-u}{t}$, $a = \frac{33-5}{t}$

$v^2 = u^2 + 2aS$, $(28 + 5)^2 = 5^2 + 2 \times a \times 50$, $1089 = 25 + 100a$, $1089 - 25 = 100a$, $1064 = 100a$, $a = 10.64m/s^2$

Students were able to answer the correctly though student 4 initially used a wrong equation but later realized it and had to use the right one.

Summary of findings 4

At the end of this lesson 94% of the students were able to

- Use Newton"s equations to solve motion problems
- Know when to use a particular equation

4.4 Lesson 4

Topic: Newton"s laws of motion

In this lesson, Newton"s three laws of motion were discussed (Appendix D). Each of the laws was taken and explained to students into details. Attempts were made to relate each of the laws to real life situations. In the first law students were made to understand that every body continues in its state of rest or uniform motion in a straight line unless it is compelled by an external force to act otherwise. Thus, if a body is at rest it wants to be at rest and if it is in motion it want to be in uniform motion (uniform speed). A student asked an interesting question: He asked whether it meant that if no external force acted on a body in uniform motion the implication was that the body will no accelerate? The Researcher answered in the affirmative. In an attempt to relate this law to real life situation the Researcher posed a question to the students: what happens to passengers in a car when the driver suddenly applies the breaks? A student answered that the passengers move forward and then backward. It was realized students were now appreciating Newton‟s first law.

In the second law, it was explained that it was explained that if a body is set in motion by a force, then the force is directly proportional to the rate of change of momentum of the body and that the momentum change takes place in the direction of the force. Quickly a student asked what momentum was; the response was given as the product of mass and velocity of a body. It was however indicated that momentum would be treated as a full topic in the next lesson so that they (students) would get a better understanding of the second law. In the last law, students were taught that to every action, there is an equal but opposite reaction. A ball was hit against a wall for students to see how it bounces back as a demonstration of the third law.

Summary of findings 5

Major findings
At the end of the this lesson, 99% of the students were able to • State Newton‟s three laws of motion • Give practical examples of Newton‟s laws of motion

General observation during classroom discourse

The observation during the lesson yielded enormous dividends for the study. The Researcher categorised the discussion on the observation into two: the teaching session and the discussion.

The teaching session

As the Researcher incorporated various cues in the teaching strategy, He personally enjoyed the teaching of physics, motivated by the students' facial expressions and other non - verbal reactions as they followed and lived the action of what was being taught. This was made possible because the Reseacher could afford eye contact, pauses and movements. The Researcher realised that his movement in the class ensured maximum attention of the class and prevented any form of distraction on the part of the students. It was palpably clear that the students were not passive listeners, their nods registered thought processing, comprehension and prediction. It was also partly due to the fact that topic of the day had a direct link with environment which aroused the interest of the students. Where students had problems with some aspects of the lesson, they easily asked for explanation without any hesitation. The topic of the day was also projected on a screen for students visualise any aspect they thought was complex to comprehend. This clearly caught the attention of the students and they remained focused during the class.

This is elucidated by Angelo and Cross (1993) in their statement that through the use of cues in the classroom, teachers can learn much about how students learn and, more specifically, how students respond to particular teaching approaches. The non-verbal cues that students provide in return are critically important, real-time feedback that influences our subsequent communication (Suinn, 2006) and allows teachers to alter our course of action if needed (Davis, 2009; Neill & Caswell, 1993). Webb, Diana, Diana, Luft, Brooks, and Brennan (1997) also state that from observation and interpretation of students" gestural cues, the perceptive teacher can decide whether there is a need to check for comprehension, provide more or a different kind of instruction, or assign more practice.

A rather profound and unmistakable observation was the unstable nature of the atmosphere of the classroom which kept oscillating between raucous, noisy interruptions and deafening silence: it was dictated by the topic (motion) I chose for the lesson, all made possible through the students' understanding of, and submission to the topic. This is what led Liu (2001) to say that research regarding the development of cues in the physics classroom has demonstrated that there are five component parts to this process. These include: "paralanguage, facial expression, eye contact and visual behaviour, gesture and body movement, and space" (p.30). Liu asserts that each of these dimensions functions differently in the classroom depending on the context of the classroom environment and the specific subject that is being reviewed. According to him, cues in the classroom serve as number of specific purposes including: expression emotions, conveying interpersonal attitudes, presenting personality, and amplifying verbal communication.

The intermittent stillness that descended over my students in the course of the teaching was dotted with an equal measure of interruption as students voiced their objections and sought clarification. In situations like this, the teaching of physics becomes interactive.

The Discussion

The discussion sessions were lively as each student had something to contribute per the relevance of the topic to the environment. In an attempt to deduce the equations for the various types of motions, everyone had something to contribute and argue apparently because the interactive nature of the topic offered them optimum understanding of the topic. In the course of the discussion, students posed questions at one another until at a point in time the situation was becoming provocative. This was because a section of the students believed that in linear motion, there was no way a car in motion could not have acceleration with a constant velocity. Clearly, these students had a misconception about the movement of a car and they were not ready to compromise the positions they had taken. At a point, having exhausted themselves, the students now calmly asked for my opinion on the issue; it was as if it had dawn on them that I was present and also had a thought of my own. Another pleasant observation I made was as I exited the class each lesson was the revival of arguments; they were going to carry on with the debate on the corridors as they waited for the next lesson.

Conclusion

This chapter entailed an analysis and discussion of data elicited by the observation and the informal interviews conducted among the students. The details of these two have been copiously elaborated upon to get an insight into students' learning of physics. The next chapter discusses the findings of the study and offers a conclusion.

CHAPTER FIVE

DISCUSSION OF FINDINGS, IMPLICATIONS AND RECOMMENDATIONS

5.0 Overview

This research set out to investigate the role of cues in improving students' learning of physics. This chapter discusses the findings of the study according to the research questions. It also sought to prove that cues hold rewards that are missing in the traditional system of teaching. The implications of the study are also outlined in this chapter. The informal interview conducted among the students was used to discuss some of the research questions. Finally, a couple of suggestions were made for further studies.

5.1 Discussion of Findings

The findings of this study have been discussed in terms of the research questions. Students" performances in the course of the lessons have also been discussed in terms of the research questions.

Research question 1: What is the perception of students towards the use of cues in teaching physics?

This research question was answered by finding 1 in chapter four, from the informal interviews conducted among the students prior to the intervention. In this interview, students were explicit about their perception towards the physics. About 90% of the students attributed their lack of interest in the physics course to a number of reasons including poor classroom discourse, the subject being difficult and teachers not up to the task. From this, there was a clear indication that students lacked interest in the physics course. Similar results were obtained by Simpson and Oliver (1990) who identified factors such as teachers‟ attitude, teaching methods and personality, attitude of parents and peers, nature and perception of the subject among components as influencing students‟ attitude towards the physics course. Negative attitude towards a certain subject makes learning or future – learning difficult (Guzel, 2004). Adepitan (2004) also remarked that the problem of understanding concepts in physics is not only common among students, it is also peculiar to teachers.

Research question 2: What methods of teaching are students used to in the classroom?

This research question was answered by finding 1 from chapter four, per the reaction gotten from the students during the interview. It was deduced from the students that 90% of the teachers were still adopting the traditional method of teaching in the classroom where teaching was teacher – centred. Thus teachers only came to class to give notes and perhaps give some few explanations where necessary without involving the students in any classroom activities. This has indeed affected students‟ conceptual understanding of physics. This is reiterated by Halloung and Hestenes (1985) who reported that the traditional lecture format in physics instruction had little impact on students in improvement of their scientific physics concepts.

Research question 3: What is the impact of cues on students when used to teach physics?

The answer to this research question was obtained by the four lessons organised. From findings 2, 3, 4, and 5, it was found out that the students began to develop interest towards the physics course. This was realised when students began to show understanding of the concepts of physics which is evident in the level of questions and answers from the students. Prior to the lessons, about 60% of answers students gave to questions posed to them were non – scientific but the Researcher was hopeful that after the intervention, students" answers would have improved.

In the course of the lessons, students were exposed to a lot of practical examples to enhance their understanding. Where some examples were far-fetched, gestures were used to illustrate whatever was being taught. The dream of any successful teacher is to be able to be able to exercise control over his class; make the class habitable and secure the attention of his students. The use of cues made students very attentive in class and actively involved in classroom activities also reflected in their performance. In the end, about 92% of the students were able to answer questions correctly. This was re-echoed by Houser and Frymier (2009) who stated that cues make learners focus on relevant materials of study thereby leading them to the right answers

Changes in the use of cues can garner the attention of students, especially if this change occurs after consistent patterns of communication with cues which has been established over time (Mackay, 2006).

In addition to improving students‟ academic performance, students were able to connect whatever they had learnt to the environment. This shows that the use of cues in teaching is unarguably an inexhaustible resource for teaching.

Finally, throughout the lessons it was revealed that the use of cues in teaching enhanced brain activity and, thus, critical thinking. The purpose of using cues in the classroom to teach physics is to deal with complex phenomena. It helps students visualise comprehensive structure of the phenomenon system, as well as enable them to study one part of the representation of the phenomenon without overlooking other parts of the system (Shapiro, Van Den Broek, & Fletcher, 1995).

Research question 4: What effective teaching strategies can be adopted to make the classroom lively?

Results from the lessons organised indicates that the use of cues particularly in the science classroom yields a lot of positive results and should be adopted by teachers even in other fields in the classroom to enhance classroom discourse. Additionally teachers could adopt the scaffolding method of teaching which is aimed at promoting deeper level learning is by supporting students during the learning process with the intention of helping them achieve their aim. It helps students to construct conceptual understanding of physics concepts by presenting problem representations that illustrate the core causal relationships of the concepts which further helps them establish the conceptual framework, conceptualise the problem and create the mental model for that specific problem.

Cooperative learning is another teaching strategy that could be adopted by teacher to make classroom discourse a desirable one. This is because cooperative environments generally foster greater learning and retention than larger modes of instruction (e.g., lectures). It also ensures that cooperation, creativity, responsibility, constructive feedback, conflict resolution skills and problem-solving skills are typically developed. Lastly, inquiry based learning could be a powerful alternative for teachers. This method of teaching seeks to actively involve students in disciplinary conversations and in their learning.

5.2 Implications of Findings

The findings of this study indicate that

1. The use of cues in teaching physics has significantly improved students" conceptual understanding of physics.
2. Frequent teacher – student interaction during classroom discourse develops students" interest in the subject.
3. The use of cues during classroom discourse makes students attentive in class.
4. Appropriate feedbacks given to students" questions spurs students on to ask more relevant questions
5. Students are able to express their understanding freely about the concept learnt.

5.3 Summary of the Study

This study was set out to investigate the role of cues in improving students" learning of physics in St. Peter"s Senior High School form one class in the Kwahu East district of the Eastern Region. The summary of the findings include

a) The use of cues helped students to comprehend complex phenomena

b) Most students were able to give the right answers to questions that were posed to them

c) Students were able understand the concept of motion and related to the environment

d) Students showed better knowledge in answering questions by using scientific terms appropriately

5.4 Conclusion

It is an obvious fact that the teaching of science today should be activity – based to enable students understand the concepts of science and subsequently apply them to the real world. The use of cues in teaching physics could help students to improve students" learning of physics. It could also help in developing their interest in the course which will enable them perform better in their examinations

5.5 Recommendations

From the study, the following recommendations were made:

a) Teachers should endeavour to incorporate the use of cues in teaching science subjects especially physics. This would help develop their interest and improve their learning of physics.

b) Teachers should make it a point to involve students during classroom discourse.

c) Most questions given to students should involve cues. This would lead students to the right answers

d) Schools should advice parents and learners about subject choice so that learners are able to make informed decisions and do not end up end up enrolling for unsuitable subjects.

e) It is proposed that teachers be provided with regular professional development regarding teaching skills so that they may be better able to understand the barriers that learners are faced with

f) Finally, it is proposed that the Ministry Of Education should prioritise equipping all schools that offer science with relevant resources in order to improve the standard of teaching and learning of science.

5.6 Suggestion for Further Studies

The following suggestions have been made for further studies:

a) This study could be conducted in a district to get a larger sample size to be able ascertain the effects of the intervention in different schools.

b) The study could be conducted in other science subject areas (biology, chemistry)

c) The attitudes of teachers in the science classroom can also be looked into.

d) This study could be conducted with a control group and an experimental group and the results will be compared

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APPENDICES

APPENDIX A

LESSON ONE

Subject: Physics

Duration: 80 minutes

Topic: Motion

Topic: Linear and non – linear motion

Objectives: By the end of the lesson students should be able to:

1. Define motion
2. Know the difference between linear and non-linear motion
3. Understand all the scientific terms under linear and non-linear motion (distance, displacement, speed, velocity, acceleration)
4. Represent the motion of bodies graphically

Relevant previous knowledge

Students have prior knowledge as to the movement of objects

Introduction

Teacher – what is motion?

Students – motion is the movement of anything

Teacher – name any type of motion you know

Students – circular motion, rotational motion and linear motion

Teacher – what is velocity

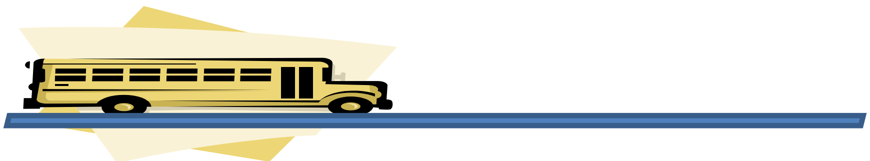
Students – it is the movement of a car

Lesson notes

A. LINEAR MOTION

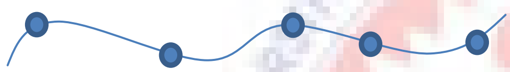
This refers to the movement of an object in a straight line.

Example of linear motion

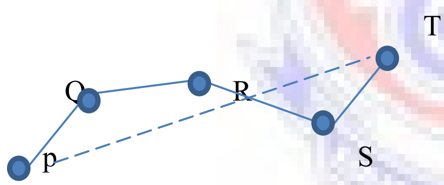


B. NON – LINEAR MOTION

Example of non – linear motion

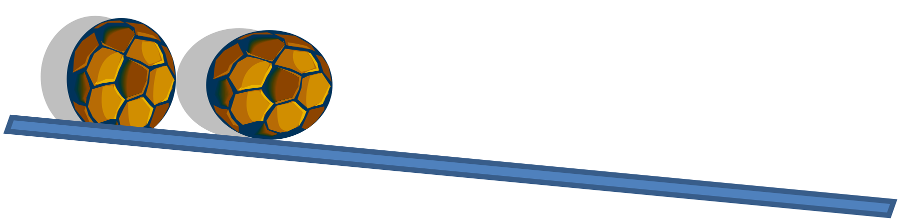


C. Consider the movement of the particle below



In the diagram above, because the direction of the particle is not specified, the distance can be calculated by simply adding the magnitudes of PQ, QR, RS and ST but the displacement of the particle will be the magnitude of PT. The speed and velocity of the particle can be calculated in both cases respectively.

D.

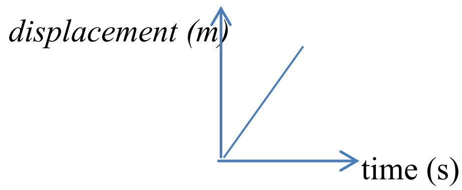


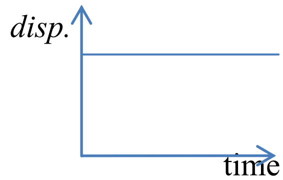
In the diagram above, the ball set in motion on that plane will accelerate.

E. MOTION GRAPHS

Displacement – time graphs

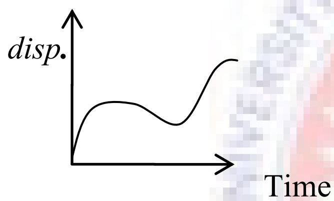
i. ***uniform velocity*** ***ii. constant (uniform) displacement***





At constant displacement the velocity is zero

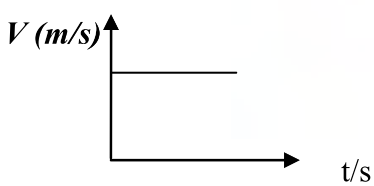
iii. Non-uniform velocity

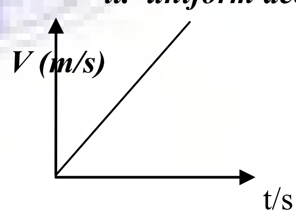


NB: The slope/gradient of displacement time graph represents velocity of the motion

Velocity – time graphs

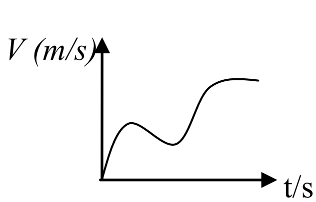
i. ***constant velocity*** ***ii. uniform acceleration***

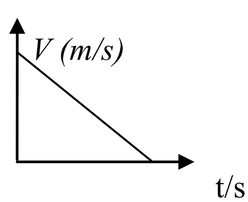




A body moving with a constant velocity has no acceleration

iii. **Non – uniform acceleration** **iv. Uniform deceleration**





NB: The slope of a velocity – time graph represents acceleration if positive and retardation if negative.

Core points

- ***Distance*** is the space between two points in an unspecified direction. It is a scalar quantity. An example is a runner making 100 metres.
- ***Displacement*** is the space between two points in a specified direction. It is a vector quantity.
- ***Speed*** is the rate of change of distance with time.
- ***Velocity*** is the rate of change of displacement with time.
- ***Acceleration*** is the rate of change of velocity with time

NB: **1.** A body moving with a constant displacement has zero velocity

2. A body moving with a constant velocity has zero acceleration

APPENDIX B

APPENDIX C

LESSON 3

F. CALCULATIONS INVOLVING LINEAR MOTION

Newton's equations:

i. $V = u + at$

ii. $s = ut + \frac{1}{2}at^2$

iii. $v^2 = u^2 + 2as$

iv. $s = \frac{(u+v)t}{2}$

Where v = final velocity, u = initial velocity a = acceleration t = time taken

APPENDIX D

LESSON 4

Subject: Physics

Duration: 80 minutes

Topic: Motion

Topic: Newton‟s Laws of Motion

By the end of the lesson students should be able to

1. State Newton‟s three laws of motion
2. Relate Newton‟s laws of motion to real life situations

Relevant previous knowledge

Students have an idea of motion in the previous lesson

Lesson notes

There are three laws of motion:

First law - It states that every body continues in its state of rest or uniform motion in a straight line unless it is acted upon by a resultant force

Second law – It states that the rate of change of momentum with time is proportional to the applied force and the momentum change takes place in the direction of the force.

Third law – It state that action and reaction are equal but opposite in direction.

IMPLICATIONS OF FIRST LAW

1. It means that no external force is required to maintain a body‟s state of rest
2. It allows a body to have the tendency to preserve its state
3. It explains the inertia of the body

NB: The inertia of a body is the ability of the body to remain at rest or its fixed position when no resultant force is applied to it.

EXPLANATION OF LAW TWO

The second law allows us to determine the force with which a body moves

i.e Force α rate of change of momentum with time

$$\text{Force} \propto \frac{\text{change in momentum}}{\text{time}}$$

$$\text{Force} \propto \frac{\text{final momentum} - \text{initial momentum}}{\text{time}}$$

But momentum = mass x velocity (MV)

$$F = \frac{k(mv - mu)}{t}$$

$$F = \frac{km(v - u)}{t} \qquad \text{But } \frac{v - u}{t} = a$$

Therefore $F = kma$

If k = 1, then $F = ma$

EXPLANATION OF THIRD LAW

The third law states that action and reaction are always equal but opposite. This law explains collision of objects. Basically, it talks about conservation of momentum during collision. It states that for any type of collision, the total momentum before collision is equal to the total momentum after collision.