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RESEARCH ARTICLE

Students' Ability Level and Their Competence in Problem-Solving Task in Physics

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ABSTRACT

This study was carried out on students' ability level and their competence in problem-solving task in physics. The study used for the study was selected randomly from four Secondary School in Kosofe Local Government Area of Lagos State.

A total of two hundred (200) randomly selected SSS Physics students in Kosofe Local Government Area served as the subject for the study. Three null hypothesis were postulated and tested at 0.05 level of significance to find student's ability level and their competence in problem-solving task in physics. The instrument used for the study was students' questionnaire and students' achievement test.

The data collected were analysed using simple regression analysis. The results of the findings showed that students' ability have significant influence on problem-solving task are discussed.

INTRODUCTION

Government, teachers, parents and the general public are greatly worried about students' poor performance and their ability levels on companies to achievement. Most state ministries of Education have taken additional steps in the recent times on school comparison to measure progress in solving the national crisis. The educational arm of the government and educators recently have shown concern about the effects of students' motivational states on how well they score on science related courses. Motivational processes help students cope with failure and keep their behaviour directed towards achieving important goal (Gear and Hamson, 2000). Early interest and positive attitude towards science learning are related to career aspirations in science. One commonly expressed apprehension among students in solving problems is that some students worry unduly about tests and suffered debilitating anxiety (Hill, 1980). The major goal of science is to develop scientifically literate individual with necessary intellectual resources to promote the development of man as a rational being (Arthur and Robert, 1975). Since educators main focus is to develop in students thinking ability of scientists required to solve problems both in and outside the classroom situations. Problem solving skill is an important part of education.

Science deals with abstraction, conceptual thinking and generalization of facts etc, all of which require the use of cognitive process. For students to achieve this, the attainment of formal operational stage is important. At formal operational stage, the child can operate logically through serration, classification, casuality, time and speed. He is also able to combine ideals, solve verbal and hypothetical problems, proportions and conservation of movement. He can transfer understanding from one situation to the other. Most of what is taught in science requires ability to think. Piaget and Inhelder (1969) discovered that many students find abstract subjects such as Physics and Chemistry difficult to learn, this is believed to be associated with their cognitive development. Many crises in science education have been partly traced to inability of students to think logically in scientific situations (Ehindero, 1892). Nzewi and Osisioma (1994), observed that the difficulty is due to not having appropriate cognitive level of comprehension and application.

The capacity of students to engage themselves meaningfully in any educational task which requires higher cognitive functioning depends on factors which include their academic potentiality. This could be tagged ability or level of academic attainment. Ability level means the characteristic mode of functioning that an individual shows in intellectual activities in a highly consistent and persuasive way (Witkin et al, 1977).

Witkin, *et al* (1977) has identified three ability levels in relation to teaching-learning situation viz: High, medium and low. High ability level learners are those that prefer isolation and social distance, theoretical and abstract ideas (akin to field independent learners). According to him, high ability individuals are better than medium or low ability group might be better in other tasks that have to do with the use of hands. In this case, the high ability group has greater ability to structure information and solve problems. However, medium ability level learners perform relatively better on learning activities involving social materials, and are more likely to require external defined goals and reinforcements (Witkin *et al*, 1977).

Many researchers (Dewyer, 1974, Kagan 1965; Stein, Pohley and Mueller, 1971) suggest that poor performance in some students occur due to their avoidance in mathematics related courses (e.g Physics) because of the notions that mathematics related courses are masculine subjects.

David and Floyd (1969), high ability learners are more intelligent than the low or medium ability learners in solving task in science courses. Intelligence, according to them, is the general level of cognitive functioning as reflected in the ability to understand ideas and to utilize abstract symbols in the solution of intellectual problems.

Friedman (1974), affirmed that some students who shows interest to science courses are superior to the nonchalant ones in solving problems of Mathematics origin.

Mortimore (1982), reported that the performance of low ability level is below average and he attributed the causes of under-achievement to social disadvantages (low income, poor health), peer influence on educational choices, quality of teaching, domination of the organization and curriculum of secondary schools by public examination and sex-differences. Some of these claims might not have anything to do with disparity in ability of students.

For better performance in science examinations, it is essential that secondary school students acquire the necessary skills of scientists. These skills can be used both in the classroom and out of the classroom situations.

Several studies within Nigerian environment have however shown that learners are qualitatively different in both their ability levels, cognitive structures and learning problems (Oyekan 1986), hence, the difference in the performances of the learners.

STATEMENT OF THE PROBLEM

The new National Policy on Education (NPE revised 1998) as well as the new National Senior Secondary School Science (Physics, Chemistry and Biology) curriculum had been sufficiently adjusted to accommodate new trends in science teaching worldwide both in its principles and practices. Poor performance of students in science subjects at the senior secondary school certificate examination (SSCE) can be attributed to inadequate acquisition in solving problems in Physics and also the ability and competence of the male students to the female students in solving problem task in Mathematics related courses and non-attainment of formal operational stage-the age at which students can think in abstraction and logically too.

This study therefore focuses on students' ability level and their competence in problem solving task in physics.

LITERATURE REVIEW

Psychologists use the term cognitive to refer to the various ways in which we know the world and try to make sense out of our life experience. Cognitive ability involves perception, logical thinking, reasoning, memory, language and problem-solving ability that allows young people to analyze, evaluate, think abstractly and occasionally challenge the information that are given by teachers, parents, peers and the media.

Ability level also enables students to understand and transfer understanding from one situation to another. Most of what is taught in science requires formal thinking ability, which is reasoning based on abstraction rather than concrete experience. Several studies within the Nigerian Environment and researchers far and wide have however shown that learners are qualitatively different in their ability levels and in learning problems (Usua 1974, Ehindero 1980).

The work of Jean Piaget and his associates constitute the largest available source of information about the cognitive development as a continous process of organization of structures, each new organsation integrating the previous one into itself. Piaget's cognitive models of development emphasize the critical rule that thinking and reasoning abilities are more advanced than those of young adults. The key point to remember is how we know the world changes over the course of childhood and adolescence and how the world has an enormous impact on ourself concept behaviour and emotional life.

Piaget identified four different stages that emerge gradually over the course course of infancy, childhood and adolescence. Each new stage consists of a more advanced way of knowing the world than what existed during the previous stage, Piaget considered the four stages and the transition between them to be universal (observed in all children), although he recognized that children progress through the stages at a significantly different place (Piaget and Inhelder, 1958).

The first stage of cognitive development according to Piaget is known as the sensorimotor stage (0-2years). During this period, intelligence is demonstrated through motor activity without the use of symbols. Knowledge of the world is limited, (but developing) because it is based on physical interactions.Physical development (mobility) allows the child to begin developing new intellectual abilities.

The second stage is known as the pre-operational stage from ages (2-7yrs) also known as toddler and early childhood. This stage is divided into two parts. The first part is regarded as the time when the child could form crude concepts and also the language to describe them start developing. The second part is when the child could classify objects on the basis of a single conspicuous feature. Intelligence is demonstrated through the use of symbols, language use matures, memory and imagination are developed but thinking is done in a non-logical, non reversible manner. Egocentric thinking predominates.

The third stage is known as the concrete operational stage (7-11 yrs) also known as elementary and early adolescent. At this stage, the child acquires the character of reversibility. Children at this stage are flexible in their reasoning than pre-school children and are capable of thinking logically but only about concrete objects and simple ideas. Their understanding of the world remains heavily dependent on immediate hands-on experience (Piaget and Inhelder, 1958). Egocentric thought diminishes.

The fourth and final stage which is of importance to this study is called formal operational stage (11-15yrs) adolescence to adulthood. At this period, the individual is already capable of thinking in abstractions. He could deal with a number of variables at a time. This period is also characterized by the acquisition of two important items. These are the logic of propositions which is helpful in discovering new kind of variants and secondly, the acquisition of a series of operational, combinational and proportional operations.

Piaget emphasized the role of process knowledge in adolescent thinking and reasoning. Process knowledge refers to knowledge about the logical strategies that underline reasoning and that account for the qualitative changes in adolescent ability to know their world (Linn, 1983). According to Piaget, each stage of cognitive development is characterized by an underlying (hypothetical) logical structure called a schema that is shaped and modified by a child's interaction with the physical and social worlds. Piaget theory thus provides a description of qualitatively different stages of cognitive development.

Literature reveals that Piagetian theory has been applied in many research studies. For example, Shayer *et al* (1976, 1986) used the model to predict the achievement of level of science students in Britain and to estimate the suitability of science and mathematics curricula for children at different stages. Their findings indicate that majority of 14-16 years old students still function at the concrete operational stage while only about 20% function at the form al operational stage.

Research done at the University of Northern Colorado has further substantiated that many students in senior high and in the university do not function well at the formal operational stage.

Arnth and Taber (1994) also documented that most adolescents and adults (in Western and non-Western cultures) do not exhibit reasoning skill that Piaget called formal operational thinking.

Further, the non-universality in attainment of formal thought as measured by Piagetian tasks has been demonstrated (Blasi and Hoeffel, 1974).

Cross-cultural studies indicated that formal operational thinking is not universal this led the acceptance that the forth stage is culturally variable (Rogoff and Chavagary, 1995). However, even if Piaget's model of formal reasoning should prove to be invalid, an important characteristic of each of the formal reasoning strategies (e.g, controlling variables, proportions, functions) is that they have practical validity. That is, problem solving in real life situations often requires formal reasoning strategies. Other important studies carried out using the piagetian model include:

1. To assess understanding of concrete and formal operation concept is by concrete and formal operational students in secondary school physics, chemistry and biology classes (Lawon, *et al.* 1978)
2. Predicting pupils potentials (Baiyelo, 1983)
3. Relationship between formal reasoning ability, acquisition of science process skills and science achievement. (Nzewi and Osisioma, 1940)

In a classic review of gender differences of Eleanor Maccoby and Carol Jaclin (1974) concluded that males have better Math and Visuaspatial skill (the kind of skills an architect needs to design a building's angel dimension), while females have better verbal abilities. Subsequently, Maccoby (1987) revised her conclusion about several gender dimensions. She said that the accumulation of research evidence now suggests that verbal differences between females and males have virtually disappeared but that the Math and Visuospatial differences still exist.

Some experts in gender, such as Hyde 1993, Hyde and Mezulis, 2001), believe that the cognitive differences between female and male have been exaggerated. Hyde points out that there is considerable overlap in the distribution of female and male sources on Math and Visuospatial Tasks.

In a national study by the U.S. department of Education (2000), boys did slightly better than girls in math and science.

The National Assessment of education Progress (NAEP) reported that in the areas of science, math and social studies, females demonstrate almost identical achievement levels as the males until about the age of thirteen. After that, female students begin to slip behind the males and the gap continues to widen through high school to adulthood. This view is supported by the researches of Goldman and Hewit (1976), Greenblatt (1962), Hadin and Dede (1975).

The concept of competence has been with us for a long time. Many qualifications are now based around definitions of competence for specific roles. Using of competence springs from the idea of that having a good grasp of knowledge and theory behind a subject does not guarantee the ability to turn that into competent performances.

Competence is also used to work with more general descriptions of the requirements of human beings in organizations and communities. Examples are educational and other organizations who want to have a general language to tell what a graduate of an educational level must be able to in order to graduate or what a member of an organization is required to be able to do in order to be considered competent.

An important detail of this approach is that all competences hav e to be action competences, which means you slow in action, that you are competent. Competence is also required during recruitment processes, and subsequently to measure and improve employee development. Infact, job descriptions are a basic definition of knowledge, skill and attitude that are required to a given role. Being competent in any thing is a mixture of these three things.

Competence can easily be defined as "ability to perform activities to the required standards using an approximate mixture of knowledge, skill and attitude". All these aspects must be present if science is to be effective in what ever he or she is to do. In order to increase competence, on will need to increase not only knowledge but your understanding of how that knowledge can be applied, your skill in applying it, and the attitude to apply it correctly. For example, if you are given a problem to solve in physics, You also have to have the skills and attitudes needed to solve the problem. Before you start to solve the problem, you need to define four things:

1. What you need to be competent to do?
2. The knowledge, skill and attitude that make up that competence
3. What level of competence you need to be competent i.e, whether a basic knowledge of the subject is adequate or do you need an advanced knowledge.
4. What you could do to prove that competence i.e, solving the problem given.

Defining what task you should be competent and what level is not an easy one to do but is made easy at secondary school level as one's level of competence is determinant on the content of the curriculum provided by educational bodies e.g WAEC, NECO etc. which are in use in schools today. However, it is the job to the teachers to help students acquire the necessary knowledge, skills and attitude necessary to perform certain activities to the required standard when and where ever tested. Students should also turn the habit of seeking for problems to solve so as to check how competent they are in their fields i.e, what knowledge has been gained.

For a student to develop a certain level of competence, at varying levels of expertise, in different areas, an amount of time needs to be spent. They may take an interest in certain areas and therefore wish to develop same to a very high level, while advance in others may not feel as important or relevant to them as they are most likely to be weaknesses. However, one has to remember that it takes an appreciable time to develop competences; and in order for one to remain competent in a particular area, continuous practice/use of knowledge and associated skills is necessary or one will lose his proficiency.

Formal scales for assessing competence in schools are, example; achievement test, teacher made test, practical work, projects, laboratory work, e.t.c. Here, teachers are trained to judge levels of competence against set standards i.e, using A,B,C,D,E or F. One's competence can however be measured by a logical addition of the students scores in achievement test, teacher made test, practical work, projects, laboratory work etc. The final score gotten will tell you the category and level of competence a student has attained. The grades can also be used to observe and measure their improvement.

This is the lowest level of competence. At this point, you do not know that there is anything to learn.

It is when you do not know what you do not know. You are aware of your lack of skill and knowledge. You are in a state where you deny usefulness of certain skills. You do not understand people's answers because you haven't begun to ask questions. You have no motivation to learn because you don't understand how ignorant you are.

Problem solving is a fundamental part of learning physics. However, many physics instructors find that their students do do not solve problem at the desired level of proficiency (Relish, Scherr, and Tuminaro, 2006; Reif, 1995; Van Heuveen, 1991). To help improve the teaching and learning of physics problem solving,studies commenced in the 1970's and early 1980's to understand these difficult tasks (McDermott and Redish, 1999). Since that time, systematic research into physics proble solving has become of importance as a primary subfield of physics Education Research, or PER (Hsu, Brave, Foster & Harper 2004) which has grown substantially in the past few decades.

The capacity to solve complex problem is an essential skill for citizens in today's changing technological society (Martinez, 1998). Infact, some institutions visit problem solving as a desired outcome for all students, regardless of their choice area of study. As students continue to study, they are expected to possess the ability to identify, define and solve problem.

The context of physics present a good opportunity for students to engage in problem solving. In learning major concepts and principles of physics, problem solving skills is considered a primary goal of physics instruction at all levels of education (Hsu et al, 2004; Redish et al, 2006). Problem solving skill is a goal of great value to the society and it cannot and has not be over emphasized if students are to learn quantitative and qualitative problem solving skills.

Research literature on problem solving extends into several disciplines, including cognitive science, psychology, education, mathematics, and physics and they can be categorized into several categories, including: definition of ''problem'' and 'problem solving', cognitive aspect of problem solving (such as use of representation, strategies, knowledge, structures and cognitive load and working memory), expert-novice characteristics of procedures and knowledge structures, problem solving in mathematics and its transfer to the contexts, e.t.c, but the first three of these categories will be explored to a greater extent.

Attempts to describe what is meant by a 'problem' and problem solving' are surprisingly consistent.

For example, Newell and Simon (1972) write that, "A person is confronted with a problem when he wants something and does not know immediately what series of action he can perform to get it"". (p.72). Similarly, Martnez (1998) states, "problem solving is the process of moving towards a goal when the path to the goal is uncertain" (p. 605). One commonality within these definitions is their subjectivity. What is considered a "problem" for one person may not be a problem for another person. The definition depends on the perceived difficulty of the task (Hsu et al, 2004). Problem-solving also depends on a person's prior experience; some skills can be learned well enough that they become automatic and require minimal effort (Ormrod, 2004). One thing that is for sure is that where there is difficulty, there is no problem.

The basic components of a problem are considered to be information provided or an initial state (givens), a desired end state (goal) and means to get from the initial state to the end state, (operations) (Ormrod, 2004). Problems differ vastly in their structure. On one extreme of the continuum are problem that are straightforward, that clearly state the givens and desired goal, and for which all information needed to solve the problem "correctly" present. These are referred to as well defined problems (Ormrod, 2004; Pretz, Naples, and Sternberg, 2003). On the other extreme are problems for which the desired goal could be uncertain some necessary information is absent for which there might be general possible solutions. These are termed ill-defined problems. The degree to which a problem is considered well-defined or ill-defined depends on an individual's expertise, and therefore solvers will differ in their problem-solving approach and strategies. For expert problem solvers, it is possible they will be represented with a problem and know immediately the steps to use in solving it. In such a situation, one can make a distinction that it is not a "problem" for them at al, but rather can be classified as an "exercise".

Cognitive psychologists described seven steps that comprise a problem solving cycle (Pretz et al 2003). They assert that a problem solver must first recognize the existence of a problem and identify it, define and represent the problem, develop a strategy or plan to reach a solution, recognize his or her knowledge, allocate mental and physical resources to the problem, monitor progress towards the goal and evaluate the solution.

How you identify, define and represent a problem is mediated by a variety of internal and external factors. Internally, existing knowledge and expectations tame the interpretation of a problem and mediate the capacity to represent the problem efficiently. Other internal factors such as individual differences in abilities and dispositions can also affect the problem solving process; for example, persons with high spatial abilities are more likely to represent problems with the use of images rather than linguistically. The external factor of social context (Peers, Culture and Languages) can affect the type of problem that can be recognized by a group, and terms used to describe a problem.

Early psychological theories to describe problem solving were based on the ideas of trial-and-error behaviour and stimulus-response association from Edward Thorndike's classis observation of animals in puzzle boxes from the early 1990's and additional observation of young children, psychologists concluded that the trial-and-error behavior is a generally ineffective and time consuming approach to problem-solving and is only workable if there is a limited number of possibilities to try. Based on these observations, Psychologists such as Thorndike, Pavlov, and Skinner developed the idea of conditioning based on stimulus response connections, which focused on observable stimulus in the environment and organism's response to stimuli. This spective of learning became known as behaviourism, because research was based on observable behaviours that could be measured.

In early theories of learning and problem-solving, psychologist focused their research only on process that can be observed and measured; therefore they largely excluded internal processes from studies (Ormral, 2004). Although behaviourist and neo-behaviorist approaches can be used to explain some aspects of human behavior such as problem-solving, they have largely been abandoned in favour of the cognitive perspective. This shift in the field began with what is called Gesalt psychology, and then further developed into information processing theory, which remains a prevalent theory today.

Information processing theory of memory is the basis on which contemporary theories of learning and problem solving. In brief, this theory asserts that information in the brain is stored in two primary components of memory: short term or 'working' memory and long term memory. Short term memory is limited in size and the length of time it can hold information, and is thought to contain distinct verbal and visual parts (Redish, 2003). In contrast, long-term memory can hold vast quantities of facts and data for long periods of time, but to access this information must be activated by being brought into working memory.

In problem solving, it is thought that working memory is utilized to process information about the problem and maintains its accessibility during the problem solving process Since working memory had limited storage capacity, it is impossible that information in a problem can exceed this limit and interfere with attempts to seek a solution. For this reason, information about a problem is often stored externally (written down) or processed eternally (such as with a calculator or computer) in order to free up space in working memory that can be devoted to the task. Also, some skills in problem solving can be traced until they become automatic, which will minimize the use of working memory capacity.

In addition to utilizing short-term memory, problem-solving required accessing relevant information-the solvers knowledge base about the problem-from storage long-term memory. Critical factors in this retrieval of information include what has been stored and how it is has been stored, and the patterns present in the problem that help the individual perceive what information to access from memory. In order to retrieve information, knowledge from a content domain must be present in memory to begin with; it should also be organize in a way that facilitates its retrieval in an appropriate context.

With experience in a context domain, it is believed that problem solvers develop cognitive called "problem schemata" that allow them to recognize a problem as belonging to a particular category (Sweller, 1988). This mental classification of problem types can trigger particular actions for solving the problem, based on the perceived similarity of the presented problem top the same category of others stored in memory. There is evidence that expert and novice problem solvers differ in their problem schemata.

The cognitive approach to problem solving also the concept of metacognition, which refers to an individual's awareness of his or her own thing process (Martinez, 1998; Ormrad, 2004). Meta-cognitively engaged problem solvers have developed skills at planning their problem solving approach, monitoring their progress toward the goal while following their plan, and evaluating the effectiveness of their chosen strategies. Since metacognitive solvers are careful to evaluate their assumptions and less apt to persevere in an unproductive strategies, they are most likely to solve complex problems successfully.

Descriptions of operations or methods for solving problems often draw a distinction between algorithm and heuristics (Martinez, 1998; Ormrod, 2004; Pretz et al 2003). The term algorithm is usually applied to step-by-step procedures that will guarantee a correct solution every time, if applied correctly. An example of an algorithm is the mathematical procedure for carrying out long division (Ormrod, 2004). The term heuristic is used to refer to general strategies or "rule of thumb" for solving problems.

As cited in Ormrod (2004), one general solving strategy includes defining the problem and gathering information relevant to its solution (preparation), thinking about the problem at a subconscious level while engaging in other activities (incubation), having a sudden insight into the solution of the problem (inspiration) and checking top be certain that the solution is correct (certification). A difficulty with the usefulness of this strategy, however, is that it is not clear – how to facilitate the occasion of inspiration, and extended periods of incubation are not always feasible.

The mathematician Polya is often cited for his 4-step problem solving strategy. His first step is understanding the Problem, by identifying the unknown, the data ends the condition, and then drawing a figure and introducing a suitable notation. The second step is devising a plan in which the solver seeks a connection between data and unknown. If an immediate connection is not found, the solver considers related problem or problems that have already been solved, third step, carrying out the plan, the steps outlined in part two are carried out, and each step is checked for corrections. In the find step looking back, the problem solution is examined, and arguments are checked.

Reif's steps include Analyze the Problem, in which a basic description of the situation and goals is generated, and a refined physics description according to time sequences and interval is developed (Ref, 1995). The second step is construction of a solution, in which basic useful relations are identified and implemented until unwanted qualities are eliminated. The final step is called checks, and asks the solver if the goal has been attained, the answer in terms of known quantities, and there is consistency within the solution in terms of units, signs and sensibility of values.

The research literature on problem solving has shown difference between experienced (or "expert") problem solves and those who are inexperienced (or "novices") both in their procedures for solving problems and their organization of knowledge in memory (Chi, Feltovich, and Glaser, 10980; Larkin and Reif, 1979). In Physics problem solving, novice students tend to spend little time representing the problem and quickly jump into quantitative expressions. Instructors have found that novice students implement problem solving techniques that include haphazard formula-seeking and solution pattern matching.

In contrast, experts solve problems by interjecting an additional step of a quantitative analysis or a low-detail overview of the problem before writing down equations. This quantitative analysis used by experts, such as a verbal description or a picture, serves as decision guide for planning and evaluating the solution. Although this step takes additional time to complete, it facilitates the efficient completion of further solution steps and in most cases the expert is able to successfully complete the problem in less time than a novice (Pretz et al, 2003). This description also often explores the constraints inherent in the problem, such as expectations for extreme values check or evaluation of the problem solution.

In addition to differences in procedures, experts and novices differ in their organization of knowledge about physics concepts (Larkin, 1979, 1980) suggested that experts store physics principles in memory as "chunks" of information that are connected and can be usefully applied together, whereas novices must inefficiently access each principle or equation individually from memory. As a result of this "chunking" of information, the cognitive load on an expert's short-term memory is lower and they can devote more memory to the process of solving the problem (Pretz et al, 2003; Sweller, 1988). Fro a novice, accessing information in pieces places a higher cognitive load on short-term memory and can interfere with the problem solving process.

Chi *et al* (1980) found that experts categorize physics problems based on underlying structure or physics principles involved, whereas novice look at the surface features of the problem such as the objects mentioned in the problem description. They further hypotheses sized that these categorizations indicate that the problem schemata of experts and novices contain different knowledge which influence their problem representations and the approaches used by these experts and novices.

In most introductory physics courses, students' problem solutions on homework on exams are given a score based on the correctness of the algebraic or numerical solution (Heller et al, 1992). A standard grading practice in physics involves giving students partial credit for particular characteristics of their written solution, as compared to the ideal solution developed by the instructor, as compared to the ideal solution developed by the instructor. Simply comparing average scores based on this grading scheme, however, does not give an adequate description of the students' problem solving performance. At best, it only gives an indication of whether one solution is "better" than another in terms of the prescribed grading scheme. A different kind of instrument is required to determine the nature of a student's approach to the problem and assess a solution in terms of characteristics of "expertise" in solving problems.

Research into problem has several different means to measure problem solving performance. One method used by Larkin and Reif (1979) involves measuring the time it takes a problem solver to write down each quantitative expression in their solution, and recording the total time to reach a solution, and recording the total time to reach a solution. Some researchers have also investigated problem solving using think-aloud protocols or interviews, in which students engage in conversations to explain their thinking processes as they attempt physics problem. A difficulty with this method is the time involved to prepare and conduct them, the vast amount of data generated from interview transcriptions, and the complicated nature of data analysis. In order to compare problem solving performance of many students for many students, it is desirable to have a qualitative measure that can be determine quickly.

An investigation described by Heller, Keith, and Anderson (1992) uses a rating scale of problem solving performance based on six characteristics of expert-like problem solutions. These characteristics include evidence of conceptual understanding, usefulness of the problem description, and consistency of the specific equations with the physics exception written, reasonableness of the plan, logical progression of the mathematical solution from physics principles to problem-specific expressions, and the use of appropriate materialistic. The characteristics in this scheme are weighted equally and normalized to obtain a score out of 100 points.

However, it is necessary that a standard method (i.e., one that is recognized universally) for measuring problem solving performance should be made. It should be easy to use, less time consuming, easy to collect and record data, easy manipulation and also easy to understand. If almost all of these is achieved because there is no situation as perfect then, there will be uniformity and comparison of scores across schools can be achieved thereby bridging the gaps between educational institutions.

In a research carried out by Patrick (2005) entitled student representational competence and self-assessment when solving physics problems. Patrick investigated student representational competence in two large-lecture algebra based introductory university physics courses with approximately 600 participants total. His purpose was to examine student performance on homework problems given in

four different representational formats mathematical, pictorial, graphical, verbal, with problem statements as close to isomorphic as possible.
The participants were 546 and 367 student algebra based introductory physics classes at the University of Colorado at Boulder.
The instrument used was students' college algebra. The course was on-sequence second semester class physics 202 and physics 201 in the fall of 2004. This course precedes 202 in the standard sequence, but this particular 201 section took place the semester following the 202 class mentioned above, and so each group was being exposed to the study for the first time. The recitation and laboratory section of the courses was taught by the lecture professor and another professor working together. The recitations focused on working through problems rich in context in small groups, with some demonstrations and some time reserved for homework and exam questions.
The results which focus on comparisons of student performances on similar problems in different formats and comparisons of student performance in choice and random-assignment control recitation section. The first result shows the fraction of students in both choice and control sections that answered each of the twelve homework (HW) problems four formats in three different topics correctly. The second result shows the performance of the students on each format of each in-recitation quiz, grouped by whether they were in a choice or control section.
Patrick concluded that in the case of the Bolor-model homework problem, the performance difference between the nearly isomorphic graphical and pictorial problem is due to students selecting a particular distractor. This distractor is one that superficially resembles energy-level diagrams that they have seen associated with this material, but only when it is represented pictorially. He also said that students in the random-format groups doing much better on a pictorial-format spectroscopy quiz than on a verbal format of that same quiz. Patrick therefore recommended that students can perform better on different assignment representations of problems if they depend on a number of things, including student expectations, prior knowledge, meta-cognitive skills, and the specific contextual features of the problems and the representations. Patrick also recommended that a complete understanding as student representational competence will need to attend to the specific and general features of the problems, the courses and the learners.

PURPOSE OF THE STUDY

The main purpose of the study is to investigate students' ability level and their competence in problem solving task in physics.

RESEARCH HYPOTHESIS

In the study, the following null hypotheses were formulated:

$H0_1$:There is no significant relationship between student's ability level and problem solving task in physics

$H0_2$:There is no significant relationship between the stages of cognitive development and problem solving task in physics.

$H0_3$:There is no significant relationship between teaching-learning and problem solving task in physics.

METHODS

A simple survey design was adopted for this study. The study was directed at the population of all senior secondary physics students from Kosofe Local Government Area in Lagos State. The sample selection was limited to four (4) senior secondary schools that have been exposed to the recommended physics scheme of work. The four schools were selected by means of simple random sampling technique. In each of these four schools, 50 students were randomly selected from each school across SS1 to SS3 giving a total population of 100 males and 100 females in an effort to eradicate the problem of gender discrimination. This brings a total sample of 200 students.

INSTRUMENT

Data were collected using two basic instruments: student questionnaires and physics student achievement test. The questionnaire consists of two sections. Section A was designed to capture the

biodata of the students while section B consists of seventeen item questions to assess the level of cognitive development in relation to physics.
The second instrument administered was the physics student achievement test (PAT), which was designed to collect information about the performance of students on problem solving task in physics. It comprised three (3) essay questions in line with the syllabus of the respective classes.
Each question carried a total mark of ten (10). Thus, the overall mark for the test was thirty (30)

DATA ANALYSIS

The data collected were analyzed using statistical package for social sciences (SPSS) and questionnaire processing software for market research (QPSMR) these include :Descriptive statistics (frequency, percentage, mean, standard deviation).
The data analysis and result are presented with special reference to the research hypothesis
$H0_1$: Problem solving task has effect on students' ability level in physics.
The hypothesis was tested using simple regression analysis since it is a measure of relationship between variables and the extent and magnitude of relationship between variables. In the regression model, students' ability level was used as the independent variable while problem solving task in physics was used as the dependent variable.
The summary of the data analysis is presented in table 1

TESTING OF HYPOTHESIS

Table 1: Simple Regression on Students' Ability Level on Problem Solving Task in Physics

External Variable		SS	Df	Mult. R	R-Square	MS	F	Sig (0.05)
Students' Ability Level	Regression	330.104	1	0.354	0.126	330.104	14.072	0.000
	Residual	2298.886	98			11.611		
	Total	2628.990	99					

From the above table, it is easy to see that there exists an effect on students' ability level and problem solving task in physics. This implies that problem solving task in physics determines to greater extent student ability in physics
The relationship is very high, positive and significant at 13% level of significance. Hence, the null hypothesis is duly rejected.
Further, it is necessary to find out if cognitive development influences problem solving in physics or not. To accomplish this, we used hypothesis two,
$H0_2$: Cognitive Development of Students' does not influence problem solving in physics
The hypothesis was tested using simple regression analysis. Table 4.2 gives the summary of the data analysis

Table 2: Simple Regression Analysis of the Influence of Students' Cognitive Development in Problem Solving Task in Physics

External Variable		SS	Df	Mult. R	R-Square	MS	F	Sig (0.05)
	Regression	3.836	1	0.045	0.206	3.836	14.072	0.000
	Residual	1859.404	98				14.072	
	Total Total	1863.240	199					

The table above reveals that cognitive development influences problem solving task in physics. This implies that problem solving task in physics. This implies that problem solving task in physics influence students cognitive development. The relationship is significant at 21% and has no significant impact on cognitive development of students. Hence, the null hypothesis is accepted.
Furthermore, we establish if teaching-learning of students influences problem solving task in physics.
H03: Teaching-learning does not influence problem solving task in physics

The hypothesis was tested using simple regression analysis.
Table 3 gives the summary of the data analysis

Table 3: Simple Regression analysis of Teaching-Learning and Problem Solving Task in Physics

External Variable		SS	Df	R	R-Square	MS	F	Sig (0.05)
Teaching Learning	Regression	32.137	1	0.131	0.172	32.137	5.720	0.000
	Residual	1831.103	98			9.248	5.720	
	Total	1863.240	199					

The table above reveals clearly that there exists a significant relationship between teaching-learning and problem solving task in physics. This implies that teaching-learning influences problem solving task in physics. The relationship is significant at 17% and has a significant impact on teaching-learning in physics. Hence, the null hypothesis is rejected.

DISCUSSION AND CONCUSION

The result of the analysis of data in chapter four shows that students engagement in problem solving task on physics determines to a greater extent, students; ability in physics. This also shows the importance of engaging students in problem solving exercise so as to build their innate abilities. It also tells us that students who shy away from problem solving will likely be less productive when it comes to physics problem because they may have the ability but since it has not been developed (to think and reason) they lack to know how to operate in that field. This finding, however corroborate with the work of Piaget (1958) and his associates on development as a continuous process of organization of structure, each new organization integrating the previous solving. He also emphasizes the critical role that thinking and reasoning play in development of human as a whole. This also foes further to show that before one can effectively function in his environment or field, he must have gone through a process of developing the necessary skills. This is also demonstrating in humans as growth and development occurs i.e., before a child can speak, he must babbler, before he can walk, he must crawl. Etc.

Therefore, the development of students' abilities should be of great importance as it shows a high and positive significance in problem solving which also relates to the effective learning which will return result in higher level of achievement to the individual, society and the nation at large.

The research results obtained from the data analysis indicate that there is no significant relationship between the stages of cognitive development and problem task in physics. This is supported by the view of Arntt and Taber (1992). The documented that most adolescents and adults (in Western and non-Western cultures) do not exhibit reasoning skill that Piaget called formal operational thinking.

The non-Universality in attainment of formal thought as measured by Piagetian task has been demonstrated by Blasi and Hoeffe (1974). Cross-cultural studies carried out by Rogoff and Chavagary (1995) also indicates that formal operational thinking is not universal which also led to the acceptance that the formal operational stage which is required in cognitive problem solving in cultural variable,

However, it can be said that since every human function at different levels of cognitive development,some above the expected level and other below cognitive development can not be used to determine the level of an individual problem solving-skills.

The research result obtained from the data analysis indicated that there is a significant relationship between teaching-learning and problem solving task in physics. This finding corroborate with the relevance of Piaget's theory of cognitive development to teaching and learning. He said that teachers should be aware of the developmental stage at which each child is functioning and that child should be taught only what he is ready to learn. The teachers also are to act as guides working with each child as this is his duty amongst others. They must never practice the authoritarian method of discussion with the students as it hinders free flow and understanding of what is communicated from teacher to student and student to teacher.

To help solve the problem of underachievement of physics student with regard to the students' ability level and their competence in problem solving task, the following recommendations are made based on the result of the study

- Physics teachers need to undergo further training to update their skills in teaching effectively. During training, the importance of building up of students' problem solving abilities should be emphasized.
- School administrators should see to it that forums are organized for the teachers to acquire the necessary skill for effective teaching in classrooms
- School administration should also help in the purchase of necessary materials, books etc., necessary for the purpose of education to be achieved
- The government should also provide adequate infrastructure, laboratory equipment, etc as practical work helps in making problem solvers.
- Forum for students should also be organized and emphasis should be made on personal studies as it helps in better understanding of what is taught

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