COMPARATIVE ANALYSIS OF PROSPECTIVE PHYSICS TEACHERS PROBLEM-SOLVING ABILITY AND THEIR ACHIEVEMENT IN PHYSICS

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ABSTRACT

The study compared the prospective physics teachers' problem-solving ability and their achievement in physics. Several studies have shown that new teachers have incomplete or superficial level of numerical aspects of physics knowledge. The main objective of introductory physics instruction is therefore, to enhance and facilitate students' mode of thinking from the initial common sense of perceiving knowledge to the Newtonian way of perceiving knowledge. One objective and one research question were formulated to guide the study. One hypothesis was tested at 0.05 level of significant. Correlational research design was used for the study. The total number of 53 prospective physics teachers involved in the study was determined by purposive sampling techniques. Physics problem-Solving Test (PPST) and physics Achievement Test (PAT) were used as instruments for data collection. Pretest-Posttest test were administered to the students giving the interval of 2 weeks between the pretest and postest test. The hypothesis was analyzed using Pearson product moment correlation coefficient. The findings of the study revealed a positive and significant correlation between the scores of the prospective physics teachers in the problem solving ability test and the test of achievement in physics. It also shows positive relation in gender of prospective physics teachers' problem-solving ability and achievement in physics. Thus, the study recommended among others that, during training, the importance of building up of students' problem solving abilities should be emphasized.

Key words: *Problem-Solving, Problem-Solving ability, Achievement, Reasoning ability, Critical thinking*

INTRODUCTION

Physics as a science is concerned with studying the behaviour of matter and energy, based mostly on empirical observations and quantitative measurements. Many technical or basic tools and equipment surrounding the environment work according to the laws of physics. The results obtained from the scientific research have influenced the development of other areas in science and these new developments have been widely applied to the daily life of people. As mathematics is the basic reference for all sciences; physics is also a reference for most of the applied sciences (Ovens, 1999). The basic laws of physics can only be explained by using the language of mathematics which serves as a bridge between theory and practice. However, being good in science, particularly physics is determined by the level of mastery in mathematics, which leads to proper application of the learned content to problem-solving.

Problem-solving teaching strategy is a step by step activity using varying levels of problem-solving skills such as logical reasoning ability, manipulative skills, judgment, comprehension, analyses, critical thinking, visualization and conceptualization (Adams, 2003). If these skills are carefully incorporated into classroom interaction, students will learn better and their academic achievement in physics will improve. Teaching students to solve problem is based on the hypotheses that knowledge is organized and stored in memory in sequential and logical order (Anderson, 2009) and hence it can be retrieved in a stepwise and sequential manner to solve problems (Selvaratnam, 1983 cited in Heywood, 2008). Teaching with problem-solving strategy involves the use of

"stage models". Stage models are simplified lists of stages and steps used in general problem-solving (Johnson, 2012). Polya's prescription for solving problems consists of four steps:

1. Understanding the problem (Recognizing what is asked for) Example of approaches for doing so: Asking yourself, "What am I looking for?" or "What information is given in the problem?"
2. Devising a plan for solving the problem (Responding to what is asked for) Example of approaches for doing so: Asking yourself, "Do I know a similar problem?", "Can I restate the problem?"
3. Carrying out the problem (Developing the result of the response)
4. Looking Back (Checking. What does the result tells me?)

Problem-solving process exists from realizing problem, gathering required information, examining basis of problem, searching and finding solving methods, determining best solution and problem-solving steps (Kneeland, 2001). Developing student's problem solving skills is one of the most important aims of educational institutions. Individuals should be supplied with problem-solving skills for their adaptation to social life and change (Dhillon, 2008). Thus, efforts should be made to improve teachers' knowledge and skills of problem-solving, consequently this may lead to improving students' problem solving performance in physics. Nakhleh & Mitchell, (2007) have opined that many of the students' difficulties in problem-solving could be traced to the problem-solving behaviour of the teacher .

Several studies have shown that new teachers have incomplete or superficial level of numerical aspects of physics knowledge (Carpenter, Fennema, Petersen, & Carey, 1988; Feiman-Nemser & Parker, 1990; Gudmundsdottir & Shulmun, 1987; Shulman, 1987; Tanner, 2012). A novice teacher tends to rely on unmodified problems and solution to problems (most often directly extracted from text books) and may not have coherent framework or perspective from which to present the solution. The novice also tends to make broad decisions without assessing students' prior knowledge, numerical ability levels, or learning strategies (Carpenter, etal., 1988). A prospective teacher problem-solving ability in physics is the most significant construct in relation to their achievement because it is a language for scientific and technological innovations and developments, and they usually pass the knowledge they acquire to their students. Apata, (2011) states that, the performance of students varies in terms of teachers' experience or mastery of content knowledge and pedagogical knowledge (experts and novices).

Gender issue is also at the forefront of physics education reform, as educators are trying to achieve equity in learning between the sexes. Researchers are trying to determine if establishing relationship between students' problem-solving ability and achievement in physics can lessen the apparent gap in problem-solving behaviour of men and women. The trend towards acquisition of problem-solving skills may actually have a deleterious effect on gender equity, thereby widening the performance gap between males and females (Shin & McGee, 2003).

This research work on problem solving in physics is based on Pascual-Leone's information processing theory (Pascual-Leone, 1969, 1970). This theory is a neo-piagetian paradigm which has been used as a framework to investigate scientific problems (Onwu, 1981, 1982; Niaz, 2010; Tsarparlis & Angelopoulos, 2000). This theory makes the assumption that in solving a problem, the individual's psychological system functions as a set of processes, which uses the information presented to it more than it reacts to it. The theory stipulates that when confronted with a problem or learning situation, learners use a definite information seeking strategy that is guided by their current hypotheses. The learning theory of Gagne, Ausubel, and Piaget also provide theoretical framework for studies on problem solving (Adesoji, 2008). The need for prerequisite concepts in order to facilitate the understanding of higher concepts in a learning hierarchy was stressed by the trio.

Some studies have been conducted in Nigeria in the area of problem solving in science.. Efforts had been made to formulate and trial test some problem solving models in

physics. (Egbugara, 1989; Ogunneye, 1993). Ahiakwo (1991) conducted a study to find out the extent to which students' cognitive style influenced their problem-solving ability. The overall result of the study showed that although the subjects performed poorly, the analytic style was more effective. He concluded that the subjects had difficulties not only with the recall of appropriate chemical information, but also with the methods or strategies required to reason through the problem. Abubakar & Danjuma (2012) also conducted a study on effects of explicit problem-solving strategy on students' achievement and retention in physics. The result of the study showed that acquisition of problem-solving skills generally improves students' performance. However, in view of these menace the present study aimed at determining the relationship between the prospective physics teachers' problem-solving ability and their achievement in physics.

PURPOSE OF THE STUDY

The main purpose of the study is to determine the relationship between prospective physics teachers' problem-solving ability and their achievement in physics. Specifically the study sought to achieve the following objectives;

1) Determine the relationship between prospective physics teachers' problem-solving ability and their achievement in physics.
2) Determine the influence of gender on the prospective physics teachers' problem-solving ability and their achievement in physics.

RESEARCH QUESTION

Based on the purpose, the following research questions were posed.

1) What is the relationship between prospective physics teachers' problem-solving ability and their achievement in physics?
2) What is the relationship between male and female prospective physics teachers' problem-solving ability in physics?
3) What is the relationship between male and female prospective physics teachers' achievement in physics?

RESEARCH HYPOTHESIS

1) There is no significant relationship between prospective physics teachers' problem-solving ability and their achievement in physics.
2) There is no significant relationship between male and female prospective physics teachers' problem-solving ability in physics.
3) There is no significant relationship between male and female prospective physics teachers' achievement in physics.

METHODOLOGY

The study adopted correlational research design. The population for the study was all the physics education students in all the federal universities in Nothern Nigeria. The (6) universities involved in the study were sampled using random sampling techniques and the fifty three students that participated in the study were selected using purposive sampling techniques, because the physics students in each university were not many. Two instruments used fr the were developed by the researcher, that is (4) items each physics problem-solving test (PPST) and twenty items physics achievement test (PAT). Validation of the instruments was determined by giving the instruments to two experts in Abubakar Tafawa Balewa University, Bauchi to ensure language setting and feasibility of the items. The suggestions given by the experts were taken care of by giving it back to them after the correction to ascertain that their corrections have been affected. Reliability coefficient of the PPST instrument was found using Pearson product moment correlation coefficient between raters and that of PAT was found using split half method. The reliability coefficients were found to be 0.87 and 0.72 respectively.

Before the treatment, the two groups were pre-tested using the two instruments developed on the topic Thermodynamics. At the end of the treatment of two (2) weeks, all the students were post tested. Pearson product

moment correlation coefficient was used to test the hypotheses at 0.05 levels of significance.

RESULTS

Table 1: Summary of Pearson Product-Moment Correlation between prospective physics teachers Score in the PPST, and PAT.

Group	N	oduct-Mom	sd	df	r	p
PPST	53	72.3	23.62			
				104	0.765	0.00
PAT	53	57.5				

P<0.05

The results presented in table 1 indicate a positive and significant correlation between the scores of the prospective physics teachers in the problem solving ability test and the test of achievement in physics. (N=53, df = 104, r = 0.765; p<0.05). Therefore the null hypothesis on the relationship between prospective teachers' problem-solving ability and achievement in physics was rejected at 0.05 levels of significance. The answer to research question 1 is that, there is positive relationship between the prospective teachers' problem solving ability and their achievement in physics.

Table 2: Summary of Pearson Product-Moment Correlation between male and female prospective physics teachers Score in the PPST.

Group	N	oduct-Mor	sd	df	r	p
Male	33	70.9	29.62			
				51	0.645	0.00
Female	20	67.5				

P<0.05

The results presented in table 2 indicate a positive and significant correlation between the scores of the male and female prospective physics teachers in the problem solving ability test and in physics. (N=53, df = 51, r = 0.645; p<0.05). Therefore the null hypothesis on the relationship between male and female prospective teachers' problem-solving ability in physics was rejected at 0.05 levels of significance. The answer to research question 2 is that, there is positive relationship between the male and female prospective teachers' problem solving ability in physics.

Table 3: Summary of Pearson Product-Moment Correlation between male and female prospective physics teachers Score in the PAT.

Group	N	oduct-Mor	sd	df	r	p
Male	33	65.5	23.62			
				51	0.793	0.00
Female	20	59.5				

P<0.05

The results presented in table 3 indicate a positive and significant correlation between the scores of the prospective physics teachers in the problem solving ability test and the test of achievement in physics. (N=53, df = 51, r = 0.793; p<0.05). Therefore the null hypothesis on the relationship between male and female prospective teachers' achievement in physics was rejected at 0.05 levels of significance. The answer to research question 3 is that, there

is positive relationship between the male and female prospective teachers' achievement in physics.

DISCUSSION

Based on the results presented, the study found a positive correlation between prospective physics teachers' problem-solving ability and achievement in physics. This means solving problems in physics, numerical and non-numerical constitutes the major workings in physics. This buttresses the finding of Adesoji (2008) who claimed that numerical manipulations have practical applications in physics learning. It is also in support of Anyakoha, (2008) finding who pointed out that physics laws are known to be established and accepted only if they can be measured and quantified numerically. It also corresponds with the finding of Adegboye (2007) who claimed that teaching and learning of physics is better enhanced by understanding of numerical proficiency. This also corroborate to Hsu Brewe, Fosater, & Harper, (2004) and Redish (2003) findings who states that, In learning major concepts and principles of physics, problem solving skills should be considered a primary goal of physics instruction at all levels of education.

The gender aspect of the study disagrees with Herrmann and Crowford (2008) when examining high school students complete various scientific tasks; found that males outperformed females in interpreting results. However, Lock found no gender differences in how the students planned out their ideas, completed the tasks, and communicated their results. The result agrees with Agomuoh, 2010 who mention that males and females are the same if they are treated under the same condition. Whereas it dis agrees with a study by Fatoba and Aladejana (2014) in their study on gender found slight difference in students' attitude in favour of females in Physics.

CONCLUSION

The conclusion from this study is that the better the problem-solving ability of students, the better their achievement in physics. Attention is therefore needed to improve the problem-solving skills of students in both numerical and non-numerical problems in physics with a view to improving students' achievement.

RECOMMENDATIONS

1. 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.
2. School administrators should see to it that forums are organized for the teachers to acquire the necessary skill for effective teaching in classrooms
3. School administration should also help in the purchase of necessary materials, books etc., necessary for the purpose of education to be achieved
4. The government should also provide adequate infrastructure, laboratory equipment, etc. as practical work helps in making problem solvers.
5. 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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