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The Relationship among Teachers' Problem Solving Abilities, Students' Learning Styles and Students' Academic Achievement in physics

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Abstract: This research work examined the relationship among teachers' abilities, students' learning styles and students' achievement in physics. A total of one hundred and fifty (150) randomly selected senior secondary school 11 (SS11) physics students and ten (10) physics teachers from five (5) selected schools in Lagos Mainland Local government area of Lagos State served as the subjects of this study. The simple survey design was adopted for this study. Data were gathered with the research instruments which included a learning style questionnaire administered to the selected students and a questionnaire on teachers' expertise which was administered to the selected teachers. Data was analyzed using simple regression analysis, statistical package for social science (SPSS) such as mean, percentage, t-test and analysis of variance (ANOVA).

The outcome of the findings from the study include the following

1. The relationship between teachers' problem solving abilities and students academic achievement in physics is positive and significant
2. The relationship between students' learning styles and their academic achievement in physics is positive and significant.
3. The main and combined effect of teachers' problem solving abilities, students' learning styles on students' academic performance in physics are positive and significant.

Based on these findings, it was concluded that teachers' problem solving abilities and students' learning styles have significant effects on the students' achievement in physics.

Key words:

INTRODUCTION

Over the years, complaints have been made regarding the falling standard of education in our great country Nigeria. The average students' performance in physics in the senior secondary school certificate examination (SSCE) and the national examination council (NECO) is nothing to write home about. Also the fact that physics is the most popular science subject that discourages students from studying science at the senior secondary school level is no longer news. This however does not favour the technological development and advancement of the country.

The key to scientific development is functional education as reflected in the National Policy on Education (1998). According to the policy, the laying of a sound basis for scientific and reflected thinking is the goal of primary education while the goal of secondary education is to provide trained manpower in applied sciences, technology and commerce at the sub-professional grades. Hence the major objective of teaching physics in schools is not only to communicate the spirit of science but also to ensure that students acquire the skills of science (Ogunleye, 1999).

The National Policy on Educational also indicates that sciences education shall emphasize the teaching and learning of science process and principles leading to fundamental and applied research in the sciences at all levels of education. Furthermore, the policy states the goal of science education shall be to

i. Cultivate inquiring, knowing and rational mind for the conduct of a good life and democracy.
ii. Produce scientists for national development
iii. Services studies in technology and the cause of technological development
iv. Provide knowledge and understanding of the complexity of the physical world, the forms and conduct of life

But how can these goals are achieved when students exhibit poor performance in the sciences, physics especially?

Considering the importance of science and physics in particular, it is essential to focus on teachers' problem-solving abilities to bring about desired improvement in students' learning outcome and physics most especially in senior secondary schools.

Recent studies have shown that there is a great impact of teachers' problem solving abilities on students' learning styles which in turn affects their performance. For example Rockoff (2004), Hanushek (1998, 2005)

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discovered that teachers' problem solving abilities and competence in terms of quality accounts for at least seven percent and one standard deviation increase in students' academic achievement in physics.

Thus a good physics teacher is expected to possess good teaching quality, expertise, proper management ability and good interactive skills. The importance of students' learning styles on their academic achievement in physics is not neglected. The students' learning styles refers to the independent forms or ways students receive and process information. Students vary in the way they receive and process information. This implies that their skills and preference in receiving and processing information differ. Some students may learn a new information abstractly i.e. by imaginative and verbal means while others prefer to learn concretely i.e. learning by doing. Some students learn best by working alone while others prefer group work; also some students are quick to learning while others are slow but cautious and meticulous. But it must be noted that learning styles of any kind is not an indication of intelligence but an indication of how a person simply learns. The learning styles exhibited by students depend on two major factors namely:

1. The way the students perceive situations
2. The way they process information

These learning styles can be determined from the different learning modalities which include:

a. Visual modality:- Learning best by seeing or using the sense of sight
b. Auditory modality:- Learning through instruction or teacher talk of which the sense of hearing is greatly involved
c. Kinesthetic modality:- Learning by doing and being physically involved.
d. Tactile Modality:- learning by making use of the sense of touch

These learning modalities make it possible to classify different learners into four (4) groups according to their learning styles which are:

- **Imaginative learner**: this kind of learner receives information concretely and processes it reflectively. He learns well by listening and sharing with others and integrating the ideas of others with his own experience. Such a learner prefers student-student classroom interaction.
- **Analytical learner**: This kind of learners perceives information abstractly and processes it reflectively. He prefers sequential thinking and has eyes for details. He also likes to read and values expert opinion.
- **Common sense learner**: He perceives information abstractly but processes it actively. He is very pragmatic i.e. He likes practical work and enjoys being actively involved in what is being taught especially if it is relevant to his life.
- **Dynamic Learners**: He perceives information concretely and processes it actively. Such a learner is excited in learning new things. He is a risk taker and becomes frustrated or bored if learning is tedious and too sequential.

Hence an effective physics teacher with good problem solving ability must be able to ascertain or deduce the learning styles of his or her students and modify his or her teaching style to suit the learners so that they are not marginalized. He must also possess great expertise in order to provide information to the students to guarantee meaningful learning.

With the ongoing therefore, this study was set out to determine the factors that enhance teachers' problem solving abilities and students' learning styles in order to facilitate students' achievement in physics.

Purpose of the Study:

The purpose of this study is to determine the relationship among the teachers' problem solving abilities, students' learning styles and students' academic achievement in physics.

Research Hypotheses:

The following hypothesis were tested to guide the study

H_{O1}: There would be no significant relationship between teachers' problem solving abilities and the academic achievement of physics students.

H_{O2}: There is no significant relationship between the students' learning styles and their academic achievement in physics.

H_{O3}: The main and interaction effects of teachers' problem solving abilities and students' learning styles on the achievement of physics would not be significant.

Method:

The simple survey was adopted for this study. Performance in physics was held as the dependent variable while the teachers' problem solving abilities and students' learning styles were regarded as the independent variables.

The study was direct at the population of senior secondary school 11 (SS11) physics students and their teachers in Lagos Mainland local government area of Lagos state. The schools include single sex and co-educational schools.

The sample for this study was limited to senior secondary school 11 (SS11) physics students and their teachers in Lagos Mainland local government area of Lagos state. A total of one hundred and fifty (150) students (male and female) and ten physics teachers students (male and female) were selected from five (5) different schools using the simple random sampling technique.

Instrument:

For the purpose of data collection, the instruments used in the course of this study are questionnaires and physics students achievement tests (PAT). The questionnaires were of two types: questionnaire on teachers' problem solving abilities (QTPSA), questionnaire on students' learning styles (QSLS).

The questionnaire on teachers' problem solving abilities (QTPSA) was developed on a five point Likert scale. The five responses used in the Likert scale include: strongly agree, agree, undecided, disagree, and strongly disagree.

The QTPSA was designed to determine the problem solving abilities of the teacher which include the level of teaching expertise, teaching qualities, qualification as well as ability to interact effectively with the students.

The questionnaire was divided into two (2) sections A and B, section A aimed at collecting the bio-data of the respondents while section B comprised items that assess the problem solving abilities of the teacher.

The questionnaire on students' learning styles (QSLS) was developed on a five point Likert Scale. The QSLS consisting of twenty (20) items were designed to determine the learning styles (which covers the visual, auditory, kinesthetic and tactile modalities) exhibited by each student in relation to their achievement in physics.

Finally the second instrument which is thee physics students achievement test (PAT) was designed to collect information about the performance of students in physics. It consists of four essay questions from which the students are expecting to answer three. Each question carried ten (10) marks thus the overall mark for the test is thirty (30).

Data Analysis:

The data analysis and result are presented in this chapter with special reference to the research questions and hypothesis in the study. Based on the dictate of the purpose of the study, we began the analysis by establishing if there is any significant relationship between the teachers' problem solving abilities and the students' academic performance in physics or not.

HO_1: There will be no significant relationship between teachers' problem solving abilities and the academic achievement of physics students

The analysis of the relationship between teachers' problem solving abilities and students' academic achievement in physics was tested using simple regression statistical techniques. In the regression model, teachers' problem solving abilities was used as the independent variable while students' achievement in physics was the dependent variable.

The summary of the data analysis is presented in table 1

Table 1: Simple regression analysis of teachers' problem solving abilities on students' achievement in physics.

Variable entered		Ss	Df	Multi. R	R-square	Ms	F	Sig(0.05)
Teachers Problem solving abilities	Regression	75.516	1	0.750	0.560	75.516	12.968	0.00
	Residual	3765.657	148			25.444		
	Total	3841.173	149					

The table above reveals clearly that there exist significant relationships between teacher's problem solving abilities and students' achievement in physics. The relationship is positive, very high and significant at 5% level of significance. It implies therefore that the superior problem solving abilities of teachers' playa a major role in students' academic achievement in physics. Hence, the null hypothesis is duly rejected.

Based on this finding, it is proper to establish if there exist a significant relationship between students' learning styles and their academic achievement in physics or not. To do this we use hypothesis two

Ho_2: There is no significant relationship between students learning styles and their academic achievement in physics.

Again simple regression analysis was used in testing this hypothesis, however students' learning styles was used as the independent variable in the regression model and dependent variable was the student's academic achievement in physics.

Table 2 gives the summary of data analysis of this hypothesis.

Table 2: Simple regression analysis of students' learning style on students' academic achievement in physics.

Variable Entered		S	Df	Multi. R	R-square	Ms	F	Sig (0.05)
Students Learning Styles	Regression	15.483	1	0.625	0.391	15.483	37.212	0.00
	Residual	3835.690	148		25.917			
	Total	3851.173	149					

Table 2 reveals clearly shows that there exists significant relationship between students' learning styles and their achievement in physics.

The relationship is high, positive and significant at 0.05 level of significance. It implies therefore that the students adopted learning styles is a major predictor of their achievement in physics. Hence, the null hypothesis is duly rejected.

Further, we are going to find out if the mean and interaction effects of students learning styles and teachers' problem solving abilities on students' academic achievement would be significant or not. To do this we use hypothesis three.

HO_3: The main and interaction effects of teachers' problem solving abilities and students' learning styles on the achievement of physics students will not be significant.

Analysis of variance (ANOVA) was used in testing this hypothesis. In the corrected model, teachers' problem solving abilities and students learning styles represented the independent variables and their interactions. The students' achievement in physics was the sole dependent variable.

Table 3 gives the summary of data analysis.

Table 3: Univariate analysis of variance (ANOVA) showing tests of between subject effects. (i.e. teachers' problem solving abilities and students' learning styles).

Source	Type 111 sum Of square	Df	Mean square	F	Sig (0.05)
Corrected model	427.778[a]	11	38.889	1.572	0.113
Intercept	17468.120	1	17468.120	706.218	0.000
TPA	88.684	2	44.342	1.793	0.170
SLS	222.577	3	74.192	3.000	0.033
TPA*SLS	0.000	0			
Error	3413.395	138	24.735		
Total	40096.000	150			
Corrected Total	3841.173	149			

R-square = 111 (adjusted R Square =0.041)

The relationship between teacher's problem solving abilities and students academic achievement in physics is positive and significant, the relationship between students' learning styles and students' academic achievement in physics is positive and significant, and the main and interactive effects of teachers' problem solving abilities and students' learning styles on students' academic achievement in physics are significant.

Discussion and Conclusion:

The outcome of the study shows that there exist a significant relationship between the teachers' problem solving abilities and the students' academic achievement in physics. The relationship is very positive and significant at 5% level of significance. This shows that the problem solving ability of a teacher determine to a large extend the students performance in physics. Recent research has also shown that a close relationship exists between teacher problems solving abilities, expertise level and their students' performance in physics. Recent research have also shown that a close relationship exists between teachers' problem solving abilities, expertise level and their students' performance (Gott el al, 2003).

Crawford (2005) stated that focus on processes that enhance the construction of knowledge through problem solving rather than simply the application of knowledge aligns with the goal of understanding how adaptiveness can support teachers' learning and development as they address the everyday problem of teaching thereby making them better teachers' and enhancing learning in the classrooms. The advantage of adaptive expertise in teachers' as it relates to teaching and learning has been mentioned by Shulman's (1996, 1997) theory and research on the knowledge based for teaching. Research has shown that teachers' relationship with their students as well as their ability to instill learning in them affects to a greater extent the academic performance of the students. Ajayi (1995) concluded that for the successful implementation educational programme contained in the National Policy in Education, there is a need for professionally qualified and active teachers. Observation has shown that the professionally qualified teachers are very efficient in helping students to attain academic excellence than non-professional teachers. The teacher no doubt has a greater influence on the child and his future. This is as a result of the major links that exist between the teachers, students and learning process.

Summarily, the outcomes make it evident that teachers' problem solving abilities have a significant and major impact on the students' academic achievement.

The data obtained from the research showed that students who attended schools in which teachers had a high level of adaptive expertise could learn using the various types of learning styles. Research also shows that students who can learn effectively with most learning styles have a higher ability to acquire knowledge unlike those who are not comfortable with most learning styles. A variety of researchers have attributed learning style differences to modality strength. Modalities refer to the sensory channels by which we receive and give messages. The visual, auditory, tactile and kinesthetic modalities are recognized as significant sensory channels for education (Guild &Garger, 1995). Dissertation research reveals significant findings related to learning styles and learning environment preferences. Students who were matched with learning style preferences achieved greater academic excellence than those who were not. It is therefore necessary for the teachers to understand the learning styles of the students and adjust his teaching styles to suit the learners' learning styles. Students who learn better and faster through sense of sight should be taught using clear and visible illustrations. The teacher should also make effort to enhance that his handwriting and illustrations are bold and legible. On the other hand students who learn faster through the sense of hearing should be taught using public address systems such as microphones, megaphones etc. especially in a large class setting. In a small classroom, the teacher should make great efforts to ensure that his voice is loud, clear and audible enough. Also the learning environment should be made to engage in a lot of practical work. They should be called upon to practice what they have taught as evidence shows that the learners learn best under such situations.

Summarily, students' learning styles go a long way in determining their academic achievement in physics because it determines their degree of acquisition of knowledge.

The outcome of the study shows that the main and interaction effects of teachers problem solving abilities, students' learning styles and their academic achievement in physics is significant jointly and separately at 5% level of significance.

Researchers have made great efforts to identify factors responsible for students' low performance in physics.

Bajah (1997) stated that the success of our science programme depends to a great extent on the classroom teacher. In the presence of adequate teaching equipment and materials, if the teacher is unable to make good use of such materials, this makes no difference with a situation where teaching and learning materials are unavailable. Effective learning can be establish if the teacher studies and understands his students better and adopt positive measures based on his understanding of his pupils.

The teacher is to ensure that all students are carried along in the course of teaching and they are to benefit maximally form the lesson. Hence there is great need to modify his teaching styles to suit the learning styles of the learners.

The students learning styles also goes a long way in affecting their academic performance. Students who learn best through the sense of hearing benefit more from group discussions, debates and oral essays. It is thus necessary for the teachers to engage such students in interactive discussion. Also audio aids like radio, tape recorder etc. should be utilized when teaching them. For students who learn best through the sense of sight, there is a tendency for them to benefit maximally from diagrammatic illustrated and demonstration. Hence, for these set of students, the use of visual aids like charts, poster of audio-visuals like television, computer should be incorporated into the teaching process.

The teacher should also involve his students in a lot of practical work because previous studies show that students who engaged in a lot of practical work perform better than students who do not.

This is attributed to the fact that constant practice of what has been taught enhances students' retention of the subject matter making them less susceptible to forgetfulness but enhances their power of recall.

Science, no doubt plays a role in the technological advancement of the society. This study has great implications for the enhancement of science and technology which will go along way in improving the state of our nation. Physics which is a major branch of science records low interest rate among students which has in turn affected their performance.

The outcome of this study has thus shown a significant relationship between the problem solving abilities of the teachers and the students' achievement as well as the teachers' problem solving abilities, and students' learning styles and students' academic achievement in physics jointly and separately.

The implications of these outcomes to science teaching and learning are as follows: the problem of poor academic performance in science, physics especially will continue to re-occur if the teaching style of the teacher does not suit the learners. This shows that there is a great need for the teacher to modify his teaching styles to suit the students' style of learning.

It is highly necessary that teachers possess efficient problem solving ability skills. In other words teachers are expected to possess a high level of expertise, good management abilities and should be professionally qualified teachers such facilities are rendered redundant.

As reflected in the National policy education (1998) which lays emphasis on the fact that no education can rise above the quality of its teachers, this study recommends the incorporation of certain courses into the teacher education programme. Such courses should be aimed at enhancing the teaching skills of the teacher. In-service training, workshops and seminars should also be organized occasionally to update teachers' knowledge of the current happenings and recent innovations in the teaching efficiency and effectiveness which will in-turn enhance their students' academic performance.

No two humans are totally equal hence the justification for the possession of different learning styles by different learners. This study has highlighted the various learning styles adopted by different learners. Hence, it has made easier for the learners to understand themselves better based on the learning styles they possess. This would in turn enlighten them on the appropriate modes of study to adopt which will enhance their academic performance and improve their academic achievement in physics.

Based on the results of this study, the following recommendations were made by the researchers: observation tests, interviews and questionnaires should be administered to students to assist teachers determine their learning styles. This would empower the teachers to assist their students improve their academic performance

School administrators should constantly organize seminars, workshop, conference and symposium to improve students' interest in physics. Teachers should also not be left out. They should be updated on the required measures to take in order to facilitate and improve their students' academic performance.

Teachers should also be made to undergo retaining so that their level of teaching expertise is increased and they are able to perform their duties with great ease.

The government should make adequate provisions for individuals who intend to take up science courses, physics especially, in the tertiary institutions. This will increase the availability of qualified science teachers in institutions of learning

The science curriculum should be made to include activities and exercise that would cater for the learning differences of the students.

Teaching aids, laboratory facilities and good teaching environment and conditions should be made available to the teachers and students. This will motivate them and enhance their academic performance.

From the result of the study, the following conclusions were made.

There is a significant relationship between the teacher's problem solving abilities and the students' academic achievement in physics. In other words, a teacher with high level of expertise and interactive skills would be able to present the subject matter in a comprehensive format to the learner. This will no doubt enhance the learners' performance.

Also, there is a significant relationship between students' learning styles and their academic achievement in physics. Adequate knowledge of the learning styles possessed by each learner will help them to adopt appropriate modes of study or study techniques that suit them.

Finally, the research result also shows that an interaction exists between teachers' problem solving abilities, students' learning styles and students' academic achievement in physics. This implies that a teacher with good problem solving ability will be able to modify his teaching style to suit his students' learning style thus enhancing their academic achievement in physics.

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