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Managing Students' Attitude towards Physics through Problem Solving Instructional Strategy: A Study Caried Out in Senior Secondary Schools in Makurdi Metropolis

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Abstract

The study was designed to further clarify the claims by several authors that methods of instruction could change students' attitude towards physics. It was the belief of the author that if students' were allowed to develop higher cognitive processes through problem-solving instructional strategy, their attitude towards physics might change. The topic of the study is managing student's attitude towards physics through problem-solving instructional strategy. The area of the study is all senior secondary schools in Makurdi metropolis of Benue State. 210 students were randomly selected from six (6) secondary schools in Makurdi for the study. A quasi-experimental research design was used for the study. Two groups were developed for the study, an experimental group and a control group. Problem-solving strategies were used with the experimental group, while the control group was instructed using traditional teaching methods. The data collected was analyzed using frequency, simple percentage, mean, standard deviation and ANOVA while t-test was used to test the research hypotheses at 0.05 alpha level. The findings indicated that students in the experimental group made more positive improvement in attitude towards physics than the control group, those in the PST group showed more positive attitude towards the learning of physics followed by those in the SLT group and a poor attitude scale was observed in the control group.If problem-solving instructional strategy could draw many students to offering of physics in secondary schools in Makurdi metropolis, it would be necessary for physics teachers to adopt this method so as to solve the problem of many students withdrawing from physics course at the secondary school level. This method can also be adopted and be more efficient in other country especially those having the same educational system like Nigeria.

1. Introduction

Physics is considered as the most tedious and problematic area within the scope of sciences, and it traditionally attracts fewer pupils than it other science subject like chemistry and biology, Rivard and Straw, (as cited in Olusola&Olasimbo, 2012). Physics is perceived as difficult course for students from secondary school to university and also for those in adult education graduates while in some developed countries it has been determine that goals of science are never fully realized, due to the poor performance and involvement in science courses, that student success in physics is lower than chemistry and biology, and most students have no preference for sciences, particularly physics, Reid and Skrayabina; Sengoren, Tanel and Kavcar), also as observe by Osborne and Dillon, (all as cited in Gokhan, and Tolga, 2011). It has been establish that both high school and college students find physics difficult, and as scientific discipline it is avoided because of it negative reputation.In a general analysis of the physics situation in school in England, claimed that the subject of physics and physics courses at school are only taken by student who do well and not taken as incidental additional subject likewise in Nigeria today.

Attitude according to encyclopedia of education is referred to as the predisposition to respond to certain way to a person, an event, a situation or an idea. Exploratory research has revealed the reason associated with student attitudes towards physics courses and method of teaching, Craker; Normah and Salleh; Newble's study (as cited in Olusola&Olasimbo, 2012). An individual should have new experiences and information to change his/her attitude towards an object. Erdemir and Bakiri, (as cited in Abdul, Mahammad, and Manzoor, 2011) described attitude is a tendency for individual who organize thoughts, emotion and behaviors towards psychological object, in same view human beings are not born with attitudes; rather they learn them afterwards. Some attitudes are based on people's own experiences, knowledge and skills, and some gained from other sources. They also indicated that student's attitudes and interest could play a substantial role among pupils studying science. Several studies such as Wilson; Gonen and Basaran, (as cited in Abdul *et al.*, 2011) report that student's positive attitude towards science highly correlate with their achievement in physics. It has also been establish that achievement, motivation and student interest are influenced by positive and negative attitude. Morse and Morse in a study (as cited in Naki, 2010) found that student with positive attitude towards science, had positive attitude towards their science teacher, science curriculum and science-classroom climate. Student attitude towards science is more likely to influence the success in science courses than success in influencing attitude. In this study, student's attitude towards physics through problem solving instructional strategies is to be exploited.

The measurement of students' attitudes towards physics should take into account their attitudes towards the learning environment Crawley and Black, (as cited in Olusola&Olasimbo (2012). Research has demonstrated that, the attitude towards science change with exposure to science but that the direction of change may be related to the quality of the exposure, the learning environment, and teaching method Newble; Craker, and Aiyelaagbe (as cited in Hasan and Ugur, 2011) also reported a more positive attitude of students after exposing them to self-learning strategies.. Based on this premise, several studies have been conducted to determine the factors that affect student's attitudes in physics, (Olusola*et al*, 2012). From this studies, some basic factors can be listed including; teaching-learning approaches, the use of the representation graphics, method of studying, intelligence, gender, motivation, attitudes, science teachers and their attitudes, self-adequacy, previous learning, cognitive styles of pupils, career interest, socio-economic levels, influence of parents, science teachers qualification, social implications of science and achievement. Studies have revealed the influence of methods of instruction on student's attitudes towards science, Mattern and Schau, (as cited in Hasan*et al*., 2011). These studies on attitude generally explore how attitudes influenced success. Attitudes, whether positive or negative, affect learning in sciences and particularly physics. However, it is well known that a negative attitude towards a certain subject makes learning or future-learning difficult therefore; helping students develop positive attitudes towards physics course should be considered an important step in science education.

Results from research shows that in order to increase the level of attitude and success in physics education, new teaching methods and

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technology need to be implemented into physics education. In this regard, Gok and Silay, (as cited in Naki, 2010) work on the effect of directive and non-directive problem solving on attitudes and achievement of students in a developmental science course. The result shows that attitude becomes more positive after instruction. Therefore it is reasonable to claim that the usage of problem solving strategies is more useful than conventional methods for physics learning. Learning to solve problems is a primary objective in learning science, as problems are inevitable fact of life Patton *et al.*, (as quoted by Olusola*et al.*, 2012). By solving problems, a students' success in achieving their goals will encourage them to develop positive attitudes towards physics and other problem solving activities,

Several teaching method can be used in physics teaching, problem solving is one approach. Problem-solving involves knowing what to do in the situation of not knowing what to do, problem- solving is not only finding the correct answer, but also is an action which covers a wide range of mental abilities (Abdul *et al.*, 2011). Numerous teaching methods can be used for problem solving strategies. Therefore investigation of students' attitudes, behaviors, problem solving knowledge and skills becomes important while solving a problem. Problems solving also involves a student's willingness to accept challenges. Accepting a challenge in this context means that the student is willing to find appropriate methods to solve a problem. In a study by Normah and Sallah, (as cited in Hasan*et al*., 2011) they discovered that students who can successfully solve a problem possess good reading skills, have the ability to compare and contrast various cases, can identify important aspect of problem, can estimate and create analogies and attempt trying various strategies. The effect of solving problems on a student' attitudes towards Physics is incredibly important, because problem solving requires patience, perseverance and willingness to accept risks Charles *et al*.; Udousoro, (as cited in Fakole*et al.*, 2014).

Many researchers believed that if students were allowed to demonstrate higher cognitive abilities through problem solving, either through a teacher-centered approach or a student's-centers approach, their attitudes towards physics might be positively affected. Although many researchers argue that teaching methods has a great impacts on students' attitudes to learn a subject. In this study, the effects of the problem-solving strategy on students' attitudes towards physics were investigated.

2.Methodology

The research design used for this study is a quasi-experimental design; two hundred and ten (210) senior secondary school class two (SS2) physics students were randomly selected from six schools in Makurdi Metropolis of Benue State in Nigeria.Two groups were form for this study, an experimental group and a control group. Thirty five (35) students were selected randomly from each of the six schools, and each of the two groups, teacher directed and self-directed problem-solving instructional techniques (experimental groups) and a control group was also allotted the same figure. Allocation of schools to the control and experimental group also followed a random process. The experimental group were exposed to problem-solving instructional method, one was teacher directed while the other was self-directed. The control group was exposed to conventional teaching method.

2.1Treatments

Two treatments and one instrument were developed for the study. The Problem Solving Technique (PST)to teach Projectile Motion and Equilibrium of Forces and the Self-Learning Technique (SLT),called programmed text for physics,a pre-test was given to both the control group and experimental group before treatment while a Physics Achievement Test (PAT) on topics taught after the treatment was administer to both experimental and control group to compare their performance.

2.2 Instrument

An attitude measuring scale was used for pre and posts attitude measure, which test the student's attitude towards physics before and after treatment. The attitude measuring scale was a fifteen items, with five Likert-type options. A five-point scale used was ranged from SD=Strongly Disagree, D=Disagree, QA=Slightly Agree, and A=Agree to SA=Strongly Agree. The total score for each attitude category indicates level of favorable attitude in that category.The minimum score for an item is 1, and itsmaximum value is 5.

The content of the problem solving technique procedure (PST) was controlled and validated by two physics education lecturers using face and content validity certified the procedure to be adequate for teaching steps and strategies of problem solving to teach Projectile Motion and Equilibrium of Forces. Experts in Science education and the supervisor helped to examine the 15-item attitude scale. They also helped to identify the positive and negative statements.

The reliability determination of the instrument was carried out by using Cronbach's alpha method with the scores acquired from the responses of thirty five (35) students'. Cronbach's alpha was found to be 0.81, which indicated that the student's attitude level increase after being exposed to the treatment. The questionnaire contained personal data, such as name, sex, age, and parent occupation.

In this study, prior to teaching the planned topics, both groups were given a pre-test and an attitude measuring scale for pre-test and thus, preliminary data was collected from both groups, and levels of the groups' attitude were found in equally. A post-test was administered at the end of the treatment to both the experimental and control groups to determine the effectiveness of treatment given. The attitude scale was also given after the post-test.In analyzing the data collected, the research made used of descriptive statistics (frequency, percentage, mean, standard deviation and ANOVA) to answer the research question. T-test statistics was used to test the hypotheses at 0.05 alpha level of significance.

In collaboration with a statistics expert, the researcher analyzed the data collected. ANOVA puts all the data into one number (F) and gives us one P for the null hypothesis in order to make comparison of pre-test, final test scores between experimental and control groups.

An attitude measuring scale was used for pre and posts attitude measure, which test the student's attitude towards physics before and after treatment. The attitude measuring scale was a fifteen items, with five Likert-type options. A five-point scale used was ranged from SD=Strongly Disagree, D=Disagree, QA=Slightly Agree, and A=Agree to SA=Strongly Agree. The total score for each attitude category indicates level of favorable attitude in that category.The content of the problem solving technique procedure (PST) was controlled and validated by two physics education lecturers using face and content validity certified the procedure to be adequate for teaching steps and strategies of problem solving to teach Projectile Motion and Equilibrium of Forces. Experts in Science education and the supervisor helped to examine the 15-item attitude scale. They also helped to identify the positive and negative statements.

3.Results

Data was collected for the analyses through the use of questionnaires which consist of a fifteen (15) items and a Physics Achievement Test (PAT) which consist of a ten (10) questions which were administered to students in the selected schools. The data collected was analyze using simple percentage to answer the research questions while t-test statistics was use to analyze the research hypotheses at 0.05 alpha level of significance.

3.1.1 Research Question One

What is the mean achievement score of senior secondary school physics students through problem solving instructional strategy?

Table 1: Mean and standard deviation of the pretest and post-test scores of both groups

Groups	N	Pre-test		Post-test	
		$\bar{x}$	SD	$\bar{x}$	SD
Experimental Group	140	3.04	1.211	7.37	1.391
		3.09	1.182	6.25	1.357
Control Group	70	3.02	1.181	3.09	1.16

Table 1 shows the result analyzes of the experimental and control group before teaching the plan topic. Mean and standard deviation scores of the experimental group are $\bar{x}$= 3.04, $\bar{x}$= 3.09 and SD = 1.211, SD = 1.182 before teaching, respectively. Mean and standard

deviation score of the control group are $\bar{x}$= 3.02, SD= 1.181 before teaching.

Mean and standard deviation scores of the experimental group were $\bar{x}$= 7.37,

$\bar{x}$= 6.25 and SD = 1.391, SD = 1.357 after teaching, respectively. Mean and standard deviation score of the control group was $\bar{x}$= 3.09, SD = 1.16 after teaching.

3.1.2 Research Hypothesis One

There is no significant difference between the mean achievements of physics students using problem-solving instructional strategy

Table 2: ANOVA of the scores in attitude scale of experimental and control groups before treatment

Sources of variation	Sum of squares	df	Mean square	F	Sig.
Between groups	.823	2	.721	1.876	.172*
Within groups	94.12	208			
Total	92.23	210			

* Significant at level p< 0.05

Table 3: ANOVA of the scores in attitude scale of experimental and control groups after treatment

Sources of variation	Sum of squares	df	Mean square	F	Sig.
Between groups	5.21	2	4.124	14.51	0.000*
Within groups	71.31	208			
Total	79.17	210			

In table 2, no significant difference has been found between students attitude scores of the experimental and control groups before treatment (F (2-208) =1.876, p=0.172).

In table 3, the analyses shows that there is a significant difference between attitude scores of the experimental and control groups after treatment (F (2-208) = 14.51, p=0.000).

3.2.1 Research Question Two

To what extent can physics students attitude be manage through problem solving instructional strategy?

Table 4: Mean and standard deviation of the pretest and post-test scores of both groups

Groups	N	Pre-test		Post-test	
		$\bar{x}$	SD	$\bar{x}$	SD
Experimental Group	140	3.11	1.235	5.11	.437
		3.09	1.173	4.21	.893
Control Group	70	3.07	1.178	3.09	1.19

Table 5: ANOVA of the scores in attitude scale of experimental and control groups before treatment

Sources of variation	Sum of squares	df	Mean square	F	Sig.
Between groups	0.784	2	.814	1.724	.182*
Within groups	80.46	208			
Total	89.61	210			

* Significant at level p< 0.05

As can be shown in Table 4, mean points could be considered to be equal prior to teaching. Mean and standard deviation scores of the experimental group were $\bar{x}$= 3.11, $\bar{x}$= 3.09 and SD = 1.235, SD = 1.173 before teaching, respectively. Mean and standard deviation score of the control group was $\bar{x}$= 3.07, SD= 1.1178 before teaching. Mean and standard deviation scores of the experimental group were $\bar{x}$= 5.11, $\bar{x}$= 4.21 and SD = 0.437, SD = 0.893 after teaching, respectively. Mean and standard deviation score of the control group was $\bar{x}$= 3.09, SD = 1.19 after teaching.

3.2.2 Research Hypothesis Two

There is no significant difference between physics students' attitude management and problem solving instructional strategy.

In table 5, the result shows that no significant difference has been found between students attitude scores of the experimental and control groups before administering the treatment (F (2-208) =1.724, p=0.182).

In table 6, problem-solving strategies have a positive impact on the students' attitudes scores. The analyses shows that there is a significant difference between attitude scores of the experimental and control groups after treatment (F (2-208) =16.62, p=0.000).

3.3.1 Research Question Three

What is the mean achievement score of male and female physics students using problem solving instructional strategy?

3.3.2 Research Question Three

What is the mean achievement score of male and female physics students using problem solving instructional strategy?

Table 6: ANOVA of the scores in attitude scale of experimental and control groups after treatment

Sources of variation	Sum of squares	df	Mean square	F	Sig.
Between groups	5.28	2	4.264	16.62	0.000*
Within groups	71.17	208			
Total	84.41	210			

Table 7: Mean and standard deviation of the pre-test and post-test scores of both groups

Groups	N	Pre-test		Post-test	
		$\bar{x}$	SD	$\bar{x}$	SD
Male	140	4.10	1.421	5.73	.765
		4.01	1.197	4.67	.782
Female	70	3.51	1.184	3.48	1.21

Table 8: ANOVA of the scores in attitude scale of experimental and control groups before treatment

Sources of variation	Sum of squares	df	Mean square	F	Sig.
Between groups	.813	2	.734	1.812	.150*
Within groups	76.71	208			
Total	81.07	210			

* Significant at level p< 0.05

Table 9: ANOVA of the scores in attitude scale of experimental and control groups after treatment

Sources of variation	Sum of squares	Df	Mean square	F	Sig.
Between groups	5.32	2	4.763	17.08	0.000*
Within groups	82.13	208			
Total	96.17	210			

As can be shown in Table 7, mean and standard deviation scores of the male students were $\bar{x}$= 4.10, $\bar{x}$= 4.01 and SD = 1.421, SD = 1.97 before the treatment were administered. Mean and standard deviation score of the female was $\bar{x}$= 3.51, SD = 1.184 before teaching. Mean and standard deviation scores of the male is $\bar{x}$= 5.73, $\bar{x}$= 4.67 and SD = 0.765, SD = 0.782 after teaching, respectively. Mean and standard deviation score of the female is $\bar{x}$= 3.48, SD=1.21 after administering the treatment.

3.4.1 Research Hypothesis Three

There is no significant difference in male and female physics students' achievement through problem-solving instructional strategy.

As seen in table 8, no significant difference has been found between students attitude scores of male and female students before treatment (F (2-208) =1.812, p = 0.150).

In table 9, the result from analyses shows that there is a significant difference between attitude scores of male and female students after treatment (F (2-208) =17.08, p=0.000).

4. Discussion

The purpose of the study was to investigate whether or not the problem solvingmethod has an effect on students' attitude towardsthe

learning of physics. To test the previously stated hypotheses, the scores of the control group and experimental groupsin the attitude scale before treatment were subjected to ANOVA inorder to know whether they had a different attitude towards problem solving inphysics.

This study revealed that the attitude of students in the experimental group before the administering of the treatment when compared with their mean scores of 3.04, 3.11 and 4.10 are lesser than the mean post-test of students in the experimental group. However, the attitude of students in the experimental group before the treatment is at same level with those in the control group.

However, at the end of analysis, it was found that there is a significant differencebetween attitude scores of the experimental and control groups after treatment. Result shows that there is a significant difference in the attitude of students in the experimental group after administering treatment. After comparing the mean score in the experimental group before and after the treatment, it was revealed that the means of post-test; 7.37, 5.11 and 5.73 respectively are higher than the mean of the pre-test attitude scores of the experimental group with mean scores of 3.04, 3.11 and 4.10 respectively. The resultsshowed that the attitude of the control group towards physics before and after the administering of treatment remain the same. That is, mean score of the control group before treatment were 3.02, 3.07 and 3.51 while the mean score of the control group after the treatment were 3.09, 3.09 and3.48 respectively.

5. Conclusions

Thus, the stated hypotheses 1, 2 and 3 were rejected while the alternative hypotheses were accepted. It implies that there are significant differences in students' attitude towards physics when taught using problem-solving instructional strategy inexperimental groups when evaluated with respect to problem solving method in both male and female student's attitude. This finding is in line with the works of (Fatoke, & Olaoluwa, 2014) which remarked that there is significant improvement in students' achievement when problem-solving is used in teaching science among secondary school students.Also the study conducted by Naki (2010) indicated that teaching the problem solving method to experimentalgroups was effective on knowledge and skill usage by the students in solving problems. While another study by Abdul, Mahammad, and Manzoor, (2011) also supported the result of this study by stating that Instruction Based 5Es Learning Cycle Model instruction is more effective method in enhancing student attitude towards physics subject and engage more students in Science Process Skills than the Instruction Based Traditional Teaching instruction.

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