



## **EFFECT OF INNOVATIVE TEACHING METHODS IN PHYSICS ON THE ACADEMIC PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN AKAMKPA LOCAL GOVERNMENT AREA**

**Bawan Ambrose Mbia and Udo Ndem Nsungu**

Department of Physics, Cross River State College of Education, Akamkpa

**ABSTRACT:** *The purpose of this study was to experimentally determine the effect of innovative method of teaching on the academic performance of senior secondary school physics students in Akamkpa Local Government Area of Cross River State, putting into consideration variables such as peer tutoring, problem-based learning, discovery learning and cooperative methods. Four research questions were articulated and four hypotheses were formulated to guide the study. The study employed a quasi-experimental research design. The population for the study was 6,203 senior secondary two (SSII) students in 19 secondary schools in Akamkpa Local Government Area for the 2016/2017 session. Out of 19 secondary schools, purposive random sampling technique was employed to select six schools. In each of the school selected, an intact class of the students were used. One hundred and twenty (120) students in the six intact classes constitute the sample for the study. The instrument for data collection was a 50-item 'Physics Achievement Test' (PAT). The instrument was face and content validated. Using Kuder Richardson formula 21, a reliability index of 0.80 was obtained. Research questions were answered using mean and standard deviation. Hypotheses were tested using t-test analysis at 0.05 level of significance. The result of the study revealed that students taught with the peer tutoring, problem-based learning, discovery learning and cooperative methods achieve significantly higher than those taught using the conventional method. The educational implications of these findings were discussed and various recommendations were made such as: efforts should be made by teachers to integrate thoroughly both the peer tutoring, problem-based learning, discovery learning and cooperative approaches in the teaching of physics in secondary schools; and textbooks writers should incorporate appropriately the use of these innovative teaching strategies to guide teachers and students in their usage.*

**KEYWORDS:** Innovative Teaching, Physics, Academic Performance, Students, Nigeria

### **INTRODUCTION**

Physics is a branch of Science and as a field of endeavour which plays a major role in reducing inequalities, developing powerful ways of thinking, increase the freedom to choose a wider range of career in the world of work and increasing globalization with its challenges, potentials and possibilities (Achuonye 2014). For physics and Science Education as a whole to achieve these potentials, it requires the application of suitable pedagogies at all levels of education.

The knowledge of Physics forms the basis for technological advancement of any nation. This is why Physics needs to be taught very well in order to enable students develops interest in



the subject and thus improve achievement. According to Ogu and Ohoungho in Agommuoh (2015), effective teaching is measured by the expected outcome that follows instruction. For effective teaching/learning in the classroom there must be a good teacher-students interaction, which innovative teaching promotes.

It is obvious that teaching is very challenging but the teacher owes it a duty to make sure learning has taken place. The teacher achieves this by using appropriate techniques to impart knowledge to the learners and making the learners genuinely interested and participate effectively during the teaching/learning process.

Teaching methods could be classified into traditional and innovative methods. Traditional methods include: lecture method, discussion, and demonstration, questioning and project methods. The most commonly used and the oldest in this group is the lecture method (Okechukwu 2015). It is a complete verbal presentation of the subject matter. The major advantage of the lecture method is that it would be used to cover a large content area within a very short period no matter the class size and does not require the use of the laboratory. However, it is characterized by being one-way mode of communication. Learners are always passive and so inappropriate for the acquisition of practical skills as required in practically oriented courses like Physics and leads to poor academic achievement (Ajabi in Achuonye, 2014).

Innovative method of teaching includes: peer tutoring problem-based learning, discover/inquiry, etc.

**Peer tutoring** is an instructional strategy that consists of pairing students together to learn or practice an academic task. The underlying theory is peer interaction which can have a powerful influence on academic motivation and achievement (Topping and Littleton, 2011). Peer tutoring also is an organized learning experience in which one student serves as the teacher or tutor, and one is the learner or tutee. It gives students an opportunity to use their knowledge in a meaningful, social experience (Johnson and Johnson, 2009).

**Problem-based learning (PBL)** is a student-centered pedagogy in which students learn about a subject through the experience of solving an open-ended problem found in trigger material. The PBL process does not focus on problem solving with a defined solution, but it allows for the development of other desirable skills and attributes. This includes knowledge acquisition, enhanced group collaboration and communication. It enhances critical appraisal, literature retrieval and encourages ongoing learning in a team environment in which the students are actively involved. It encourages self-directed learning by confronting students with problems and stimulates the development of deep learning (Conrad, 2014).

**Discovery Learning** is a technique of inquiry-based learning and is considered a constructivist-based approach to education (Mayer, 2014).

Bruner argues that "Practice in discovering for oneself teaches one to acquire information in a way that makes that information more readily viable in problem solving" (Bruner, 1961, p. 26). This philosophy later became the discovery learning movement of the 1960s. The mantra of this philosophical movement suggests that we should 'learn by doing'.

Discovery learning takes place in problem solving situations where the learner draws on his own experience and prior knowledge and is a method of instruction through which students



interact with their environment by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments.

**Cooperative learning** is an educational approach which aims to organize classroom activities into academic and social learning experiences. It has been described as "structuring positive interdependence. Students must work in groups to complete tasks collectively toward academic goals. Unlike individual learning, which can be competitive in nature, students learning cooperatively can capitalize on one another's resources and skills (asking one another for information, evaluating one another's ideas, monitoring one another's work, etc.). Ross and Smyth (2011) describe successful cooperative learning tasks as intellectually demanding, creative, open-ended, and involve higher order thinking tasks.

These learning techniques are practically oriented (Zimmerman and Leban, 2000), and helps to de-emphasize rote memorization of scientific concepts and principles, encourage knowledge and skill acquisitions and provide hands-on-minds learning of science, encourages active participation of learners and enhance learner's acquisition of science process skills (Okoli, 2006). Having thus x-rayed the efficacies of innovative teaching methods, the problem of the study put in question is: What is the influence of innovative teaching methods on secondary school Physics student's academic performance.

### **Purpose of the Study**

The study specifically seeks to find out:

- The effect of peer tutoring on the academic performance of students in physics.
- The effect of problem-based learning on the academic performance of students in physics.
- The effect of discovery learning on the academic performance of students in physics.
- The effect of cooperative learning on the academic performance of students in physics.

### **Research Questions**

- What is the effect of peer tutoring method on the academic performance of students in physics?
- What is the effect of problem-based teaching method on the academic performance of students in physics?
- What is the effect of guided discovery teaching method on the academic performance of students in physics?
- What is the effect of cooperative learning on the academic performance of students in physics?



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## Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

- There is no significant effect of the use of peer tutoring method on the academic performance of students in physics.
- There is no significant effect of the use of problem-based teaching method on the academic performance of students in physics.
- There is no significant effect of the use of guided discovery teaching method on the academic performance of students in physics.
- There is no significant effect of the use of cooperative teaching method on the academic performance of students in physics.

## Method

The study employed a quasi-experimental research design. Specifically, the study employed a non-equivalent pre-test, post-test control group design. The population of the study consisted of all the 6,203 senior secondary two (SSII) students in 19 secondary schools in Akamkpa Local Government Area, in 2016/2017 academic session. Akamkpa is a local government in the southern senatorial district of Cross River State. The sample for this study was 120 Senior Secondary Two (SSII) students drawn from six secondary schools offering Physics at the senior secondary school level in Akamkpa urban.

The assignment of classes into treatment and control groups was through a simple random technique. In each of the groups and schools, an intact class of the students were used.

The instrument used for data collection in this study was a 50 item Physics Achievement Test (PAT) drawn from the five identified difficult topics/areas (Temperature, Heat, Properties and wave theory of light and Current electricity) in the curriculum for senior secondary school two (SSII). The Physics Achievement Test (PAT) was face and content validated by three experts in Test and Measurement and Physics Education. The instrument was trial- tested using 40 students in another Local Government Area. The results of the trial test was analyzed using Kuder Richardson formula- 21 and a reliability index of 0.80 obtained. This result was high enough to consider the instrument reliable.

The PAT was administered to the physics students in the respective schools with the help of the physics teachers who were the research assistants in each school. Pretest was administered on both experimental and control groups before the actual treatment. Both groups were taught the selected topics in physics using innovative teaching methods by the regular physics teachers of each school; each teacher was assigned to use one of the four innovative teaching methods. After the teaching the post test was administered on both groups and the results analyzed using mean, standard deviation and t-test.



## RESULTS

The data for this research work were analyzed and presented in tables based on the four research questions and four hypotheses formulated.

**Table 1: Pretest Scores of Both Experimental and Control Groups**

Group	N	X	SD	t-cal	df	t-crit
Experimental	90	35.25	3.50			
Control	30	34.50	2.75	1.21	118	1.96*

\*not significant

Table 1 shows that prior to the use of innovative teaching (peer tutoring, problem-base, discovery and cooperative) methods in the teaching of Physics by Physics teachers in the experimental group, their mean score was 35.25 and a standard deviation of 3.50. The control group had a pre-test mean score of 34.75 in the Physics Achievement Test (PAT) and this is slightly lower than the experimental group. This shows that the range of scores between the experimental and control group was very narrow.

More so the table shows that the calculated t-test is less than the critical value, hence, there is no significant difference in the pre-test scores of the experimental and control groups. This indicates that both groups are homogeneous and any variation in performance in the post-test could rightly be attributed to treatment.

**Research Question One:** What is the effect of peer tutoring method on the academic performance of students in Physics?

This question was answered by the data presented in table two (2).

**Table 2: Post-Test Mean Achievement Scores of Physics Students Taught with Peer Tutoring Method**

Group	N	X	SD	Mean Gain
Peer Tutoring	24	65.92	2.56	30.67
Control	30	50.60	4.65	16.10

Analysis of table 2 shows that after the treatment; which was teaching the students in both groups, the post-test mean score for experimental students taught using peer tutoring method improved appreciably from 35.25 to 65.92 and a decrease in standard deviation from 3.50 to 2.26. There was also an increase in the mean score of the control group from 34.50 to 50.60 and an increase in standard deviation from 2.75 to 4.65. The mean gain difference for was 30.67 for peer tutoring method and 16.1 for the control group. This implies that physics students taught with peer tutoring method performed better than those taught using the conventional method.



**H<sub>01</sub>:** There is no significant effect of peer tutoring method on the academic performance of students in physics.

**Table 3: T-Test Analysis of the Mean Achievement Scores of Students Taught Physics with Peer Tutoring Method and Those Taught with Conventional Method**

Group	N	X	SD	t-cal	df	t-crit	Decision
Peer Tutoring	24	65.92	2.56				
Control	20	50.60	4.65	15.40	42	2.01	Significant

In table 3 above, it shows that the calculated t-value (15.40) is higher than the critical value (1.96), this implies that there is a significant difference in the performance of students taught Physics with peer tutoring than those taught with the conventional method. The null hypothesis which states that there is no significant effect of peer tutoring method on the academic performance of Physics students is hereby rejected at 0.05 level of significance. This implies that there is significant effect on the performance of students taught Physics using peer tutoring.

**Research Question Two:** What is the effect of problem-based learning method on the academic performance of students in Physics?

This research question was answered using data and result presented in table four (4).

**Table 4: Post-Test Mean Academic Achievement Scores of Students Taught Physics with Problem-Based Learning Methods and Those Taught with Conventional Method**

Group	N	X	SD	Mean Gain
Problem-Based	24	64.92	3.70	29.67
Control	30	50.60	4.65	16.10

Table four above shows post-test mean scores of students taught with problem-based method of teaching and conventional lecture method (control). The experimental group had a mean score of 64.92 and standard deviation of 3.70 while the control group had a mean score of 60.60 and a standard deviation of 4.65.

Referring to table 1 (pre-test scores), the result shows that there is a difference between student's pre-test and post-test scores with a mean gain difference of 29.67 for experimental group and 16.1 for control group. These implies that students taught with problem-based learning method perform better, hence problem-based learning method affect Physics student's academic performance positively.

**H<sub>02</sub>:** There is no significant effect of the use of problem-based method on the academic performance of students in Physics.



**Table 5: T-Test Analysis of Mean Achievement Scores of Group of Students Taught Physics with Problem-Based Learning Method and Those Taught with Conventional Method**

Group	N	X	SD	t-cal	df	t-crit	Decision
Problem-based	24	64.92	3.70				
Control	30	50.60	4.65	12.56	52	2.01	Significant

From table 5 above, the calculated t-value is higher than the critical value, hence the null hypothesis which states that there is no significant effect of the use of problem-based learning method on the academic performance of Physics students is rejected at 0.05 alpha level. This implies that there is a significant effect in the academic performance of Physics students taught using problem-based learning method.

**Research Question Three:** What is the effect of discovery learning method on the academic performance of students in Physics?

**Table 6: Mean Achievement Scores of Students Taught Physics with Discovery Method and Those Taught Using Conventional Method.**

Group	N	X	SD
Discovery Method	22	64.72	3.95
Control	30	50.60	4.65

Table 6 shows the post-test mean scores for both the experimental group and control group. The experimental group had a mean score of 64.72 while the control group had a mean score of 50.60.

Table 6 further shows a mean gain of 29.47 for experimental group and 16.10 for control group. This implies that students taught Physics with discovery method of teaching perform better as shown in their mean gains.

**H<sub>03</sub>:** There is no significant effect of the use of discovery learning method on the academic performance of Physics students.

**Table 7: T-Test Analysis of the Mean Achievement Scores of Students Taught Physics with Discovery Method**

Group	N	X	SD	t-cal	df	t-crit	Decision
Discovery method	22	64.72	23.95				
Control	30	50.60	4.65	11.77	50	2.01	Significant

From the calculations in table 7, the calculated t-value (11.77) is higher than the critical t-value (1.96). Hence, the null hypothesis which states that there is no significant effect of the use of discovery learning method on the academic performance of Physics students is rejected at 0.05 alpha level. This means that there is a significant effect of the use of discovery teaching method on the academic performance of Physics students.



While the control group had a mean score of 50.60.

**Research Question 4:** What is the effect of cooperative learning method on the academic performance of students in Physics?

**Table 8: Student's Mean Achievement Scores in Physics Achievement Test (PAT) Taught with Cooperative Method and Control Groups.**

Group	N	X	SD	Mean Gain
cooperative method	20	69.70	3.10	34.45
control	30	50.60	4.65	16.10

Table 8 shows that students in the treatment (cooperative) group has mean score of 69.70 and a standard deviation of 3.10 while the control group has a mean score of 50.60 and a standard deviation of 4.65. Furthermore, table 8 shows a mean gain of 34.45 for the experimental (cooperative) group and 16.1 for control group. Since the mean gain is higher, it implies that the students perform well when taught Physics with cooperative method of teaching.

**H<sub>04</sub>:** There is no significant effect of cooperative teaching method on the academic performance of Physics students.

**Table 9: T-Test Analysis of the Mean Achievement Scores of Students Taught with Cooperative Method and Those Taught with Conventional Method.**

Group	N	X	SD	t-caldf	t-crit	Decision
Cooperative Learning	20	69.70	3.10			
Control Group	30	50.60	4.65	17.36	48	2.01 Significant

The above table shows that the calculated t-value is higher than the critical value. Hence the null hypothesis which states that there is no significant effect of the cooperative learning method on the academic performance of Physics students is rejected at 0.05 alpha levels. This means that there is a significant effect in the academic performance of Physics students taught with cooperative teaching method.

## FINDINGS OF THE STUDY

The major findings of this study, based on the research questions and the hypotheses are summarized below:

- The pre-treatment means test scores of experimental groups were 35.25 and 34.50 for control group.
- The post-treatment scores were 65.92, 64.92, 64.72 and 69.70 for peer tutoring, problem-based, discovery and cooperative method respectively.
- Each of the four groups recorded higher mean score in the post-treatment test than in the pre-treatment test.



- Students taught Physics with cooperative teaching method had highest mean scores (69.70) in the post-treatment mean scores than those with peer tutoring (65.92), problem-base (64.92) and discovery method (64.72).
- The students taught Physics with discovery method recorded least mean score than the other experimental groups.
  - The test of the hypothesis showed that: There was a significant effect on the academic performance of students taught Physics with peer tutoring method.
  - There was a significant effect in the academic performance of students taught Physics with problem-based method.
  - There was a significant effect in the academic performance of students taught Physics with discovery teaching method.
  - There was also a significant effect on the academic performance of students taught Physics with cooperative teaching method.

## DISCUSSION OF FINDINGS

The students that were taught with peer tutoring, problem-based, discovery and cooperative method were found to have high achievement scores in the PAT than their counterparts in the control group. These findings are in agreement with some earlier findings of Alio (1999), Idoko and Oladimeji (2002), Ajewole (2013) and Achuonye (2014). These researchers observed that the students in the experimental group who were allowed to interact and carry out activities in group performed better than those in the control group who were passive listeners in their Physics classes. The innovative (peer tutoring, problem-based, discovery and cooperative) methods used in this study were activity oriented and encourage students-teachers, student-students and students-materials interaction.

Students in the experimental group who recorded high performance, were taught with the use of more activity-oriented teaching methods. The activity nature of the teaching methods makes the students to provide relevant answers to the PAT questions than their counterparts in the control group that were not exposed to the activity-based method. This agrees with Eta (2012) who stated that adoption of good and thought-provoking teaching methods, under a conducive learning environment leads to mastery of the learnt materials by students. And thus, higher achievements.

Students taught with cooperative teaching method perform significantly better than those taught with peer tutoring, problem-based, discovery methods. The students taught with cooperative method had a mean score of 69.70, in the PAT as against 65.92, 64.92, 64.72 for peer tutoring, problem-based and discovery method respectively. This shows a positive impact of cooperative method in the teaching of Physics over the three methods. This finding is in agreement with Ibitoye (2011) and Eze (2003) when they stated that cooperative method being an innovational approach has greater impact on student's academic achievement in Physical Science and other related practical science subjects.



The result of the hypothesis revealed that the mean performance scores of the different groups of students taught with different methods differed. The test scores recorded by students depend greatly on the teaching methods employed by the Physics teachers. This therefore agrees with Udo and Bawan (2016) when they found out that the performance recorded by students in Physics lessons is solely dependent on the attractive and stimulating nature of the method (s) employed by teacher of Physics. This implies that each of the innovative method vary in their efficacy as for as Physics teaching is concerned.

## CONCLUSION/ RECOMMENDATIONS

From the foregoing findings, and discussion it could be concluded that:

- Most students taught with peer tutoring, problem-based learning, discovery and cooperative (Innovative) teaching methods performed well in the achievement test items, when compared with those taught with conventional method.
- Generally, students taught with the use of cooperative method performed better than those taught with other innovative teaching methods. Hence it implies that the development and introduction of more virile and result oriented instructional approaches in physics classrooms should be encouraged. It is recommended that Secondary school teachers should avoid the continuous use of conventional lecture method in the teaching of physics and should aggressively adopt innovative teaching methods in physics in all classes at the secondary school level with the intention to promote students' performance. Also, textbook writers should consider it as a priority, to include in their texts, the uses and application of peer tutoring, problem-based learning, guided discovery and cooperative methods in the teaching and learning of physics so that the teachers and learners should apply them when the need arises.

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