EFFECTS OF MENTORING ENHANCED STRATEGY ON SELF-REGULATION IN PHYSICS AMONG SECONDARY SCHOOL STUDENTS IN BENUE STATE, NIGERIA

Abstract

The study determined the effects of mentoring enhanced strategy on secondary school students' self-regulation (SR) in physics in education zone 'C' of Benue State, Nigeria. The study was guided by two research questions while two hypotheses were formulated and tested at 0.05 level of significance. The design of the study was the quasi-experimental, non-randomized, pre-test and post-test control groups. The population of the study consisted of 4,064 SS Two physics students in the 94 schools in Education Zone C. The sample comprised 406 SS Two physics students drawn from 10 schools using multi-stage sampling technique. The research instrument adapted and used for data collection was Students' Self-Regulation Scale (SSRS). The research instruments was subjected to a reliability analysis using Cronbach's Alpha Formula which yielded a reliability co-efficient of 0.85.. Data collected were analyzed using discriptive statistics of mean and standard deviation to answer the research questions while inferential statistics of Analysis of Covariance (ANCOVA) was used to test the hypotheses. The findings revealed that students who were exposed to mentoring exhibited higher self-regulation levels (P = 0.007<0.05) than those students who were not exposed to mentoring. There was no significant difference between male and female students' self-regulation level (P = 0.036>0.05). Based on these findings, it was recommended among others that the use of mentoring enhanced strategy should be encouraged and used in physics instruction in secondary schools.

Key Words: *Physics, Self-Regulation, Mentoring Enhanced Strategy*.

Introduction

The socio-economic development of any nation is strongly rooted in the level of her scientific and technological advancements. The world is full of experiences that require explanations such as the colours of rainbows and soap bubbles, the vapor trails of high-flying aircraft. The world also want to understand the fact that liquid water abruptly changes into solid ice at a certain temperature, the production of lightning and the thunder that follows it in a storm, the beautiful hexagonal symmetry of small snowflakes and the limitless list of other phenomena, fall within the province of the science of physics which need simple explanation (Pember, 2014). The essence of science in general is the observation and exploration of the world around humans with a view to identifying some underlying order or pattern in what is found. According to Wenno (2014), Physics is that part of science which deals primarily with the inanimate world which further is concerned with some efforts to identify the most fundamental and unifying principles. Physics, therefore is important in helping students to receive the depth of knowledge and skills that guarantee these scientific and technological advancements (Musa, 2017).

According to the American Physics Society (APS) (2015), physics is the most basic and fundamental science. Other related science subjects like chemistry, geology through to biology and cosmology are better understood by the concepts developed in physics. In addition, many of the tools on which the advances of science and technology depend on are direct products of physics. The interests and concerns of physicists have therefore always formed the basics of future technology.

Physics is crucial to understanding the world around us, the world inside us and the world beyond us. Physics has a lot of usefulness on our lives in many ways such as in medicine with the use of X-rays, radioisotope and nuclear magnetic resonance imaging. In addition, lasers electron microscopes, synchrotron radiation and electronics all depends on advances and discoveries made in physics. Physics is therefore, the most basic of the physical sciences. Physics challenges one’s imaginations with concepts like relativity and string theory that leads to great discoveries like computers and lasers which also lead to technologies which change human lives from healing joints to treatment of cancer and also in developing sustainable energy solutions. The application of physics in industry and many other fields makes it important for comfortable living in the modern age of science and technology (Pember, 2014; Mashi, Inkani & Yaro, 2014). Physics as a subject has remained one of the most relevant science subjects that those in medicine, pharmacy, astronomy, space science, Information Communication Technology (ICT) and engineering and other aspects of science majorly depend on (Aina &Akintunde, 2014).

The idea of mentoring in education is as old as the educational system itself. Mentoring is the act of supporting and encouraging younger ones to manage their learning behaviours for career success by older individuals (Anagbogu & Nwokolo, 2015). This is a useful tool that helps young ones to develop new ways of communicating information, making decisions, responding to environment and interacting effectively. Achor and Duguryil (2014) see mentoring as a means of helping a novice to be properly guided on the rudiments of curriculum, teaching and learning.

Mentoring in physics means to support and encourage young students studying physics to manage their own learning in order that they can maximize their skills, improve their performance and become the person they want to be, as well as have an opportunity to think about options and progress. Mentoring is a powerful personal development and empowerment tool. It could be an effective way of helping young physics students to enhance their understanding and progress in their careers. It is a partnership between two people (mentor and mentee) normally working in a similar helpful relationship based upon mutual trust and respect (Buell, 2004).

According to Encarta (2014) dictionary meaning of a mentor is refered to as a guide, a tutor, pilot, counselor, who can help a mentee to find the right direction to develop solutions to career issues and problems. Self-regulation is recognized as the learning that takes place when an individual is a meta-cognitively, motivationally and behaviorally active participant in his or her own learning (Wheeler & Wischusen, 2014). According to Shunk and Pajares (2009), a self-regulated student is a goal setter who is able to seek help, manage time, self-evaluated, modify his/her environment and strategize in order to achieve set goals.

Statement of the Problem

Students find it difficult to understand physics concepts such as light waves, electricity, mechanics, heat and energy as reflected in the poor and unsatisfacory performance of candidates in the Senior Secondary School Examination (SSCE). This Students' dwindling performance in physics in public examinations in Benue State in recent past has had serious implication on the advancement of science and technology education in the State. This usually affects enrolment of students in science disciplines like Medicine, Engineering, Space Science and training of quality science teachers in tertiary institutions in Benue State. This situation is worrisome to both teachers and parents. One of the critical issues that has become a focus in recent development is the issue of the ability of regular classroom lessons to meet the learning requirement of low performing students in science subjects especially in physics. It is now thought that complementing classroom lessons with other teaching strategies may improve learning and performance in physics.

Purpose of the Study

The purpose of this study was to examine the effect of mentoring enhanced strategy on self-regulation in physics among senior secondary two students in Benue State, Nigeria

1.3 Research Questions

Two research questions guided this study:

1. What effect does the use of mentoring have on physics students' mean scores in self-regulation levels between those who where exposed to mentoring and those who were not?
2. What is the difference in mean scores between the self-regulation levels of male and female physics students who were mentored?

Hypotheses of the Study

Two hypotheses were formulated and tested at 0.05 level of significance:

1. There is no significant difference in mean scores between mentored and non-mentored physics students on self-regulation levels.
2. There is no significant difference in mean scores between mentored male and female physics students' self-regulation levels.

Research Design and Sample

The quasi-experimental design was adopted for the study. It is the non-randomized, pretest - post test control group design.

The sample for the study consisted of 406 SS two physics students made up of 188 males and 218 females from Education Zone 'C' of Benue State. This sample was drawn from 10 schools using a multistage sampling technique. This was carried out through stratified sampling technique and random sampling techniques. Ten schools were selected through stratified sampling which were purposively sampled from the 94 government approved schools across the study area. Gender was the criteria used for the stratified and purposive selection. The schools selected had presented candidates for the West African Senior School Certificate Examination (WASSCE) and National Examination Council for Senior School Certificate Examination (NECO SSCE) for five years and were well equipped and had functional physics laboratories. The justification for the choice and use of purposive sampling technique was to ensure that schools selected had facilities for teaching Physics. These resources included physics teachers who are professionally trained graduate teachers and had spent five years on the job. This removed the disparity of schools in terms of relevant facilities as a threat to validity of this study.

Reseach Instrument

The instruments used for the collection of data for the study was:

Students' Self-Regulation Scale (SSRS)

The SSRS was originally developed by Sheier and Carver in 1982 and was adapted by Wheeler and Wischusen in 2014 as Motivated Strategies for Learning Questionnaire (MSLQ). The Motivated Strategies for Learning Questionnaire (MSLQ) was modified to suit the purpose of this present study as it was renamed Students' Self-Regulation Scale (SSRS). It consisted of two sections, A and B. Section A required the demographic information about the respondents; name, school and gender, while section B consisted of statements on respondents' self-regulation cognitive mechansm in physics learning. It was based on a five point Likert Scale. The respondents were required to express the extent of their agreement and disagreement in order of Stongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD). The positive items were scored 5 to 1 while the negative were scored 1 to 5. The SSRS consisted of 21 items.The SSRS instrument is attached as Appendix. The Reliability of the instrument namely SSRS, was trial tested on 75 SS two physics students from three different schools outside the main sample for the study. The instruments were administered on the students by the research assistants and collected immediately. The test scores obtained from SSRS was analyzed using Cronbach's Alpha formula and the reliability coefficient of SSRS was found to be 0.85

Experimental Procedure

The Researcher organized two days training session for the research assistants for the experimental group and control group seperately. The training covered the following areas: The content of physics taught, the use of lesson plans, lesson notes and guidelines, the procedure for administering the instrument and the general conduct of the study. The study scheduled lasted for eight (8) weeks, one (1) week for preparation/familiarization and administration of pretest instruments, six (6) weeks for treatment and one (1) week for administration of post-test instruments.

Method of Data Analysis

The data collected were analyzed using descriptive statistics of mean and standard deviation to answer the research questions. The hypotheses were tested using inferential statistics of Analysis of Covariance (ANCOVA) at the significance level of $P \leq 0.05$.

Research Findings

4.2.1 Research Question 1

What effect does the use of mentoring have on physics students' mean scores in self-regulation levels between those who where exposed to mentoring and those who were not?

The data which provided the answer to this research question are presented in Table 1.

Table 1: Mean and Standard Deviation of the Effect of Mentoring on Physics Students' Self-Regulation for those Mentored and those Not Mentored.

Method		PreSSRS	PostSSRS	Mean Gain
Mentored Group	Mean	3.2315	3.8142	0.58
	N	212	212	
	Std. Deviation	0.44643	0.42880	
Conventional Group	Mean	3.1884	3.7884	0.06

	N	194	194	
	Std. Deviation	0.55097	0.55097	
Mean Difference				0.52

The analysis of data on Table 1 presents the mean gain in self-regulation levels of students who were exposed to mentoring as 0.58 and those who were not as 0.06. The mean difference between the self-regulation levels of those students who were exposed to mentoring and those who were not was 0.52 in favour of those students who were exposed to mentoring. This result revealed that students who were taught using the mentoring enhanced strategy exhibited high self-regualion levels than those who were taught using the conventional strategy.

Research Question 2

What is the difference in mean scores between the self-regulation levels of male and female physics students who were mentored?

The data which provided answer to this research question is presented in Table 2.

Table 2: Mean and Standard Deviation of Self-Regulation Levels of Male and Female SS two Physics Students' mentored.

Gender		PreSSRS	PostSSRS	Mean Gain
Male	Mean	3.3095	3.8095	0.50
	N	96	96	
	Std. Deviation	0.43336	0.43336	
Female	Mean	3.3444	3.8498	0.51
	N	116	116	
	Std. Deviation	0.45438	0.45802	
Mean Difference				0.01

The analysis of data on Table 2 shows the mean self-regulation levels of male and female students who were mentored in physics. The table indicates that the mean gain of male students is 0.50 and that of their female counterpart is 0.51. The mean difference between the two mean gains is 0.01 in favour of female students. This implies that SS two female physics students who were exposed to mentoring had high self-regulation levels than their male counterpart.

Hypothesis 1

There is no significant difference in mean scores between mentored and non-mentored physics students on self-regulation levels.

The data for testing hypothesis one is presented in Table 3.

Table 3: ANCOVA on Mean Scores of Mentored and Non Mentored Physics Students on Self-Regulation Levels.

Dependent Variable:Post SSRS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	96.190[a]	4	24.048	7.636	.000
Intercept	4.185	1	4.185	1.329	.000
PreSSRS	94.993	1	94.993	3.016	.000
Method	.023	1	0.023	7.370	.007
Error	1.263	401	0.003		
Total	5965.867	406			
Corrected Total	97.453	405			

a. R Square = .987 (Adjusted R Squared = .987)

Table 3 presents ANCOVA result of mentoring effect on students' self-regulation levels in physics. Pre SSRS were used as covariate to control the initial difference among the two groups (experimental and control). Results from the table revealed that the F-ratio $F(1,401) = 7.370$ and the significant value $p = 0.007$ for method. The significant value (p) is less than the set value ($p < 0.05$) for the study. The null hypothesis 1 is therefore rejected which means that there is significant mean difference between mentored and non-mentored students on self-regulation levels in physics. Based on evidence from the data analyzed the conclusion drawn was that mentoring in physics significantly improved self-regulation levels of SS two physics students.

Hypothesis 2

There is no significant difference in mean scores between mentored male and female physics students' self-regulation levels.

The data for testing hypothesis two is presented in Table 4.

Table 4: ANCOVA on Mean Scores of Mentored Male and Female SS two Students' Self-Regulation in Physics.

Dependent Variable:Post SSRS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	37.600[a]	2	18.800	3.284	.000
Intercept	2.255	1	2.255	393.943	.000
PreSSRS	37.555	1	37.555	6.560	.000
Gender	.005	1	0.005	0.858	.355
Error	1.196	209	0.006		
Total	3122.973	212			
Corrected Total	38.796	211			

a. R Square = .969 (Adjusted R Squared = .969)

Table 4 presented an ANCOVA result that is significant. The table reveals that F(1,209) = 0.858 and p = 0.36 > 0.05. The null hypothesis 2 that there is no significant mean score difference between mentored male and female students' self-regulation levels in physics was however, rejected.

Conclusion was based on evidence from data analysis that there is no significant mean difference between male and female students that were mentored based on their self-regulation levels in physics.

Discussion of Findings

The discussion of findings was tailored along the purpose of the study which was to examine the use of mentoring enhanced strategy in upgrading self-regulation in physics among senior secondary two students in Benue State, Nigeria. Findings revealed that the mean scores of students who were in the experimental group were higher than those who were in the control group. The difference was confirmed in Table 1 to be significant. This implies that students who were taught using the mentoring strategy attained higher self-regulation level than those who were taught using the conventional strategy. This was further confirmed by the hypothesis 1 tested in Table 3. That mentoring had a significant effect on students' self-regulation levels in physics. This implies that students who were exposed to mentoring in physics attained a higher level of self-regulation than those who were not exposed to mentoring. Findings on the influence of mentoring on self-regulation levels of male and female students in physics showed that the mean gain of female students were higher than that of their male counterpart. This implies that the use of mentoring in upgrading self-regulation of students is gender sensitive and it was in favour of the female students. To check if the difference in the mean gain was significant, hypothesis 2 was test and the analysis in Table 4 revealed that there was no significant mean score difference between self-regulation levels of male and that of female students who were mentored in physics.

The improvement in the development of students' self-regulation levels in physics could be attributed to students exposure to the mentoring strategy. The high level attained could be because the mentee is metacognitively, motivationally and behaviourally active in his/her learning process. The mentee is purpose driven, active and constructively involved in the learning process. Also the factors in the mentoring processes such as the mutual and personal interaction (mentor-mentee relationship), hands-on-learning-activities by the mentees with their mentors could have given an edge over the conventional strategy in physics instructional classroom.

The finding of this study is in agreement with that of Morgan, Sibthorp and Tsethlikai (2016) who found out in their research that Youths that were exposed to mentoring treatment during summer recreation programme attained greater increase in self-regulation over time than the Youths that were not exposed to mentoring treatment.

The finding of this study also agrees with that of Wheeler and Wischusen (2014) who proved that mentoring programme had a positive impact on some but not all the aspects of students' regulatory ability. The biology intensive orientation for students (BIOS) which was a mentoring programme new biology students was reported to have calibrated students' self-regulation and self-efficacy for optimal performance in biology. The result showed tha BIOS participants exhibited higher self-regulation and self-efficacy in biology final grades than their non-BIOS peers. This offers insight into the mechanism behind the success of science boot camp and the role of motivation and meta-cognition. The result of this study again has a promising implication for the power of mentoring to improve students' self-regulation skills as examined in this study.

Conclusion

Based on the findings of this study, it was concluded that students' self-regulation levels in physics was upgraded by the use of mentoring enhnced strategy. The study has therefore provided and established some empirical bases in education zone 'C' of Benue State for optimising classroom teaching and learning of physics through the use of mentoring enhanced strategy.

The implication of the findings was that the SS two students who were exposed to mentoring strategy had an upgraded self-regulation mean scores in physics than those who were exposed to the conventional strategy. The study also revealed that the female students who were mentored attained higher self-regualion level in physics than their male counterpart. The use of mentoring strategy is gender-friendly and can be futher utilized to narrow the gap in gender disparity in physics performance and interest levels.

Recommendations

Based on the findings, it is therefore recommended that:

1 To maximize and stimulate interest and enthusiasm of students towards physics learning and performance, physics teachers are encouraged to use mentoring strategy in the teaching of physics (have a mentor-mentee relationship).

2. In-service seminars, workshops and symposia should be organized for the training of physics teachers on the use of mentoring enhanced strategy in teaching by the government for science teachers associations and other relevant bodies.

3. There is the need to ecourage the use of mentoring strategy right from the training stage of teachers to let them know that self-regulation is a key cognitive factor that could influence learning of physics.

4. Educators should therefore encourage targeting the development of self-regulated learning in their classrooms.

5. Curriculum planners should modify senior secondary physics curriculum to include the use of mentoring as an instructional strategy to enhance students cognitive variables such as self-regulation to better academic performance not just in physics but in other science related subjects.

6. The use of mentoring as an instructional strategy should be encouraged because it is capable of reducing gender disparity and thereby reducing the gap in gender difference in the study of physics.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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