EFFECT OF PLOTTING GRAPH USING EXCEL SOFTWARE ON ACADEMIC ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENTS' IN PHYSICS IN CALABAR EDUCATION ZONE OF CROSS RIVER STATE, NIGERIA

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Abstract
The paper was aimed at investigating the effect of using Microsoft excel software in plotting graph as an instructional resource on academic achievement of secondary school two physics students in Calabar Educational zone of Cross River State, Nigeria. To achieve the objective of the study, a hypothesis was formulated. Review of literature was done accordingly. The study adopted quasi-experimental pre-test-post-test non-equivalent control group research design. The population of the study comprised 2039 senior secondary school two (SS2) students offering Physics in public secondary schools in Calabar Education Zone. A sample of 98 was used for the study. The instrument considered most suitable for the study was an achievement test titled Physics Achievement Test (PAT) comprising fifty (50) objective questions covering velocity time graph in motion and ohm's law in Electricity. Analysis of Covariance (ANCOVA) was used to test the hypothesis at .05 level of significance. The result shows that teaching graph plotting in physics using Microsoft Excel software has a significantly greater effect on students' academic achievement than using the conventional graph book. It was concluded that using Microsoft Excel software in plotting graph should be preferred to using graph book. Therefore, it was recommended that government should help in providing enough computers in all the schools for effective learning of graph plotting with Excel software when teaching Physics.

Keywords: Graph plotting, Excel Software, physics, Academic achievement.

Introduction

Graphs in context of graph theory are very clearly defined as a set of nodes or dots connected by edges, which represent a relation between the connected nodes. The dots are the vertices or nodes, the connections between the nodes represent the edges. Graph theory is a well-established area of mathematics and physics that also covers methods to compare graph. Bollobas, (2010). There are vital tools for analyzing and displaying data. It allows us to explore the relationship between two quantities -- an independent variable usually plotted on the x-axis and a dependent variable usually plotted on the y-axis. In plotting a graph by hand, the key is to find a way to plot the two variables so that a straight line is obtained. The relationship between variables can often be determined by investigating different types of graphs. In plotting a good graph manually, it is necessary to keep the following points in mind in order to make more effective graphs: one need to determine the minimum and maximum values of the data in both the x and the y directions, then follow up with choosing a scale for the tick marks on the two axes. Usually you will want to use as much of the graph paper as possible and make the scale on a given axis just sufficient to cover beyond the minimum and maximum values to be plotted.

On the other hand, Microsoft excel software is used when one use a computer to fit data with a variety of functions that gives the functional relationship between the variables although the theory contains parameters you need to determine. Ercan, (2014). Several research works like Hristing, habiba and micheal have proven that in many Secondary Schools and Colleges, students have serious difficulties in understanding fundamental concepts and principles in Physics. Apparently students interpretation of observed phenomena and laboratory experiences are frequently found to be scientifically incorrect and significantly different from the ideas which their teachers intended to convey. Some students lack study habits required to help them comprehend the subject better while some students still fail exams even after preparing for it thoroughly.

Although physic, also known as the fundamental science has been the concern of researchers, science educators, policy makers and the society in general, the benefits derived from studying and applying physics concepts and principles to human life and society are large in terms of maintaining health, providing energy, communications, transportations, entertainments, manufacturing, building and constructions, human comforts, providing jobs among others. Johnson (2018) summarized this when he asserted that physics touched every aspect of human life and development.

Statement of the Problem

Though, different learning strategies have been proposed to improve meaningful learning in Physics and to determine if there exists difference between the techniques with regards to students' academic achievement, yet poor academic achievement still persist. Such techniques include the use of analogy, inquiry, cooperative learning, problem solving, constructivist models and a host of others. Several questions and assumptions has pointed towards hate for the subject, poor foundation, lack of time for students to assimilate properly, poor teaching method and strategies adopted by teachers in teaching, lack of facilities to enhance practical Physics, unprofessional handling of the subject by most teachers and a lot of others. As Plotting of graphs takes about 30% out of 100% scores during evaluation in most of the examinations in practical Physics like the WASSCE and NECO, students' content knowledge and skills in the graph plotting would have improve their achievement in Physics. Unfortunately, achievement of students in Physics at the Secondary School level in recent years particularly in examinations like NECO, WAEC and JAMB in Cross River State has been an issue of great concern among different education stakeholders. Most teachers engage in the conventional graph book method of plotting graph of some topics in Physics practical when teaching the students still no positive change is recorded. Hence, the motivation for this study which seek to find out the effect of

plotting graph using Excel software on Academic Achievement of Senior Secondary School two physics students in Calabar education zone of Cross River State.

Purpose of study
The purpose of the study is to investigate the effect of using Microsoft excel software in plotting graph on the academic performance of senior secondary school two physics student in Cross River State

Research question
What is the effect of using Microsoft excel software in plotting graph on senior secondary school two students academic performance in physics?

Statement of Hypothesis
There is no significant difference in using Microsoft excel software in plotting graph on senior secondary school two students academic performance in physics.

Literature Review
Graph Plotting
Michael (2015) in a study to explore the use of graphical representation as reasoning tools in transferring content knowledge through source processing, investigated the parameters under which students use graphs as a tool in mediating a content area (mathematics) into another (physics) He worked with 150 students that were given 2 set of problems one set required the active use of graphical representation while the other did not. Pure text problems were also admitted to control for transfer effect of established knowledge. He used ANOVA to determine if there is significant difference in the mean score of the students. The scores from these two sets came out with a result that shows that active representation of graph is powerful tool in problem solving skills of students and that the use of graph in the instructions improve academic achievement of student's in Physics and student's competency in graphical representation.

Hristing (2016) in a research of developing graphic skill of students in Physics education at Secondary schools developed a methodology for implementation of the graphical method in solving problems. The study aids perception, awareness and understanding of knowledge of physical quantities, theories, laws, processes and phenomena by students. The adopted a quasi-experimental design with a population of 1700 students and a sample size of 100. The study concluded that, the graphical method is visual, accessible and informative. She believes that graphical problems are an original didactic tool in the work of the teacher for developing student's graphical skills. solving problems of plotting and interpretation of Physics graphs, implies knowledge in mathematics and Physics related to the intuition and life experience of the students which enhance their interest in physics as a science and subject, developing their logical thinking. The study concluded that the formation and development of student graphical skills, formation of generalized knowledge of graphical method of solving physics problems, increases the level of student's graphical literacy and academic achievement in Physics.

Ekon andNwosu (2018) examines the use of activity-based approach for acquisition of science process skills towards teaching / learning of phototropism and plotting of graph. Activity-based approach was employed to engage the participants/students in order for them to acquire science process skilled for easy understanding of biology concepts and to solve some mathematical problem in biology even as it relates to solving problems in physics which students have developed phobia for. Such mathematical problems include collection of data and plotting of graphs. Follow up discussion on difficulties encountered in the activities and possible remedies were noted. It is hoped that if these activities are properly monitored by the teachers, the phobia will be reduced to the barest minimum as these activities will help students acquire

science process skills to enable them understand biology concept better and their academic performance improved subsequently.

Fernandez (2012) presents common student conceptions and misconceptions about graphs. The study adopted a survey research design, with a population of 1400, and a sample size of 96 students. It was found out that students often confuse the graph with the actual event and mistakenly use the visual configuration of the graph to describe the actual event. This is very much related to students who consider a graph as a map or picture of an event. She eventually designed a research study where she examined student approaches to graphs and features of graphs created in real-time using motion-detectors. The outcome of the result shows that students taught using graphs acquires more knowledge of the theory under study and can derive relationships of quantities. The study concluded that the academic achievement of these students were higher than the others when evaluated.

Habiba and Habiba (2014) in the study to investigate the effect of information technology in teaching students Physics course, designed a questionnaire consisting of ‗right‗,
‗wrong‗ and no ‗response‗. Survey of 150 students from high school in qualitative and quantitative was performed. Scores of physics courses in previous and later was considered. 25 students were interviewed to enhance the accuracy of the questionnaires. The result shows that there is significant relationship between information technology and teaching physics courses. Based on this result, suggestions were presented to enhance use of information technology in which Excel is one of it. Based on his study, an increase in the rate of Laptops usage in Secondary Schools can be advised since it improves students understanding in the teaching of Physics course as well as increasing their academic achievement in Physics.

Academic Achievement
Esu, (2009) opined that the most effective learning is any approach that provides the learners with opportunity to interact with what they see, touch and feel. He further added that the skillful application of this approach can transform a dull and difficult class into an exciting class. This will facilitate learning with greater output in students‗ performance because the application creates lasting impressions in the mind of the learners. This is achieved when students obtain data in the laboratory from practical experiments, plot its corresponding graphs with the use of laptops and watch the relationships between the variables or quantities.

According to Graham,(2003), Success in the classroom may be influenced by teaching methods as well as technology. He agree that graphing Excel applications do not hinder achievement in Physics classrooms. Smith and Shotsberger, (2007), Affirms that, a revised curriculum and the use of Excel graph plotting lead to a greater conceptual understanding of the content than a more traditional curriculum. There has to be a balance in the approach to calculator use in the classroom. In using the Excel graph plotting in the classroom, the teacher has to define the extent of using Excel graph plotting (Texas Instruments, 2020). Students need to know the concept or theory behind the solving a problem. There are problems that the student can solve analytically using the traditional pencil and paper, and then confirm the solution with graphing excel applications. There are some problems that cannot be solved analytically. In these cases, the excel graph plotting proves to be enormously helpful in gaining the solution and conceptual understanding of the concept Waits and Demana, (2012).

The differences in understanding are more evident with conceptual knowledge than with procedural knowledge. Conceptual knowledge is the connection of ideas to solve problems whereas procedural knowledge focuses on the symbolic representation of the problem. Greater understanding of the problem comes with a deeper understanding of conceptual knowledge. When Excel graph plotting are used as a tool to demonstrate functions, there is an improvement in conceptual Physics performance Cassity, (2017).

Ellington (2013) concluded in her meta-analysis of graph plotting that when graphing Excel applications are used in instruction but not used for the test, there was no change in the

computational skills of the student. She also concluded that when Excel graph plotting are used in both instruction and on the test, all skills improved except being able to select the appropriate problem-solving skill (Ellington, 2013). It has also been shown that if the excel graph plotting are used for the entire year as opposed to one or two topics, the student develops a better understanding of functions whether they are graphing or non-graphing (Texas Instruments, 2013).

Teachers find it difficult to justify using Excel graph plotting for the entire year because they are not sure of the benefits. Some still feel that Excel graph plotting do the work for the student and that the student does not learn. Research has shown that this is not true. As reported in the meta-analysis conducted by Ellington (2013), students showed improvement when they used Excel graph plotting in the understanding of graphical representations, understanding the relationship between the function and the graph and the visualization of the spatial relationships between the graph and the function. There is improvement in achievement when the graphing calculator is used. By its nature the Excel graph plotting can be used to reinforce the connection between the graphic form and the symbolic form. Students look for a graphical approach to the problem and can make new conceptual connections (Texas Instruments, 2013)

Physics has been studied for centuries, most obviously without the benefit of Excel graph plotting. The Excel graph plotting allows the student to visualize different functions. The student still has to know the domain and range of a function in order to see the entire function on the screen. Students are made more aware of the connection of the domain and range to the function by observing the calculator screen and how different functions have different domains and ranges. The teacher's role changes to that of a guide, helping students through various investigations on the calculator. The lesson generally begins with a discussion about the function to be studied. With carefully crafted questions, the student is directed through situations where they have to evaluate mathematical misconceptions.

Methodology

This study adopts quasi-experimental pre-test, post-test non-randomized, non-equivalent, and control group research design with $2 \times 2 \times 2$ factorial arrangements. A quasi-experimental design is an empirical study used to estimate the causal impact of an intervention on target population without random assignment. Its $2 \times 2 \times 2$ factorial arrangements because of the two moderator variables and the two groups. The groups were controlled group (denoted by C) which involves students taught without using Microsoft Excel software and experimental group involving students taught using Microsoft Excel software (denoted by E). Both the experimental and the control groups were pre-tested and post-tested.The area of the study is Calabar Education zone situated in the southern part of Cross River State, Nigeria. The State is located within latitudes $4^o27$and 5^o32North of the equator and Longitudes70^o50 and 9^o28East of the Greenwich Meridian. Geographically the zone is bounded in the north by Yakurr Local Government Area, in the South by AkwaIbom State and Atlantic Ocean, in the West by Abia State and in the East by the Republic of Cameroon.

The population of this study comprised of all the co-educational senior Secondary School Physics students in the 2020/2021 academic session in Calabar Education Zone. The researcher uses only SS2 students because they have chosen Physics as one of the subjects for Senior School Certificate Examination. This class was also preferred since those in SS1 are not sufficiently exposed to the subject. There are eighty-five (85) secondary schools in the seven (7) Local Government Areas. The students' population is 2,039. The sampling techniques adopted for the study was proportional stratified and purposive sampling techniques. In proportionate stratified sampling technique, the different strata do not have the same sampling fractions. The sample drawn from each school varies, that is there are proportionately distributed. The study area was divided into four strata. One school was drawn from each stratum making a total of four schools drawn for the study. From the four schools, two schools were urban while the

remaining two schools were rural schools. Among the school selected one urban and one rural school were used as the Experimental group and same was used as the control group. The students were drawn using purposive sampling technique from the science class offering Physics. The sample of the study consist of ninety-eight (98) Senior Secondary School two (SS2) Physics students in the study area from classes of fifty-eight (58) males representing 59.1% and forty (40) females representing 48.9%.

The instrument used for the study was an achievement test titled Physics Achievement Test (PAT) constructed by the researcher with help of the supervisor. It has two sections, Section A contained students' demographic information which include gender and school location while section B was the Physics Achievement Test (PAT) designed to measure students' academic achievement in Physics. The PAT was a multiple-choice test items comprising of fifty (50) questions covering Motion and Electricity. Twenty-five (25) questions from motion and twenty-five questions from Electricity. Each item had one correct and three distracters giving a total of four options that was dichotomously scored. The instrument measures the students' achievements.

In order to establish face validity of the instrument, draft copies were presented to two experts from the department of science education and three experts in measurement and evaluation, Faculty of educational foundation studies in university of Calabar to vet the items for face validity. To determine the reliability of the instruments, Kuder-Richardson (KR21) reliability method was utilized. The instruments were administered to fifty (50) students in secondary schools in areas that were not part of the study sample but however restricted to public schools. The result showed that the coefficient of □ 0.79 implies that the instrument is reliable and therefore was used for the study.

Result
Hypothesis one

There is no significant difference in mean achievement scores of students taught graph in physics with Microsoft Excel software and those taught with manual as an instructional resource. The hypothesis was tested using analysis of covariance (ANCOVA) with the pre-test scores as covariates. The effects of the two modes of graph plotting were compared. In order to ascertain the suitability of the test statistic, Levene's test of equality of variances was first conducted and the results ($F = .319$, $p = .753$) upheld the null hypothesis that the error variance of the dependent variable is equal across all the groups. Therefore, ANCOVA can be used. The results are shown in Table 1.

Table 1

Summary of the results of Analysis of Covariance (ANCOVA) of the effect of instructional approach on students' academic achievement in Physics.

Source of variance	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8069.298[a]	2	4034.649	2877.512	.000	.984
Intercept	8.177	1	8.177	5.832	.018	.058
Pre-test	3876.634	1	3876.634	2764.816	.000	.967
Instructional resource	16.428	1	16.428	11.716	.001*	..110
Error	133.202	95	1.402			
Total	106327.000	98				
Corrected Total	8202.500	97				

*p< .05

As shown in Table 1, the calculated F value for the main effect for instructional resource is 11.716 and it is statistically significant (p=.0001< .05). This means that there is a statistically significant difference between the mean academic achievement of students taught with Excel graph plotting software and those taught with conventional modewhen the post-test scores are adjusted for the pre-test scores. Since the adjusted mean academic achievement of students taught with Excel graph plotting software ($Mean_{adj}$ = 32.208, SE = .204) is higher than that of those taught with conventional mode ($Mean_{adj}$ = 31.078, SE = .204), it means that teaching with Excel graph plotting software has a significantly greater effect on students' academic achievement than the conventional mode. Thus, the null hypothesis is rejected.

Consequent upon the observed difference in the academic achievement of students taught with the two instructional modes, Multiple Classification Analysis (MCA) was considered. The results are shown in Table 2.

Table 2

Multiple Classification Analysis of students' academic achievement in Physics according to instructional modes

Grand Mean = 31.643

Variable + Categories	N	Unadjusted Variation	Eta squared	Adjusted for independent + Covariates deviation
Instructional strategies			.110	
Teaching with Excel graph plotting software	49	6.541		.565
Conventional mode	49	-6.541		-.565

As shown in Table 2, students taught with Excel graph plotting software have a higher mean academic achievement (mean = 31.643 + 6.541 = 38.184) compared to those taught with the Conventional mode (mean = 31.643 - 6.541 = 25.102) as stated earlier. The calculated Eta squared is .110, which implies that only 11% of the variance in students' academic achievement in Physics is attributable to instructional strategies.

Discussion of findings

The result of the study showed that teaching using Excel graph plotting software has a significantly greater effect on students' academic achievement than the conventional graph book method. This is affirmed by the findings of Ellington (2003) who concluded in her meta-analysis on a study of Excel software graph plotting that if Excel software are used in plotting graphs of some topics in a science course the student develops a better understanding of concepts which also improve their academic achievement. Habiba (2014) in her study to investigate the effect of information technology in which Excel software is one of it, concluded that there is significant relationship between information technology and teaching Physics courses. Nja and Idiege (2016) in a study on the utilization of ICT in some selected schools in Calabar municipal in Cross River State, Nigeria shows that 60% of the teachers do not have access to computers, 90% do not have access to E-reader and 50% do not have access to good laboratory where data are obtained from experiments to aid student understanding of the concept been taught. From these analyses the academic achievements of student in Physics is been reduced as there are no sufficient equipment like the computer for using Excel software in the plotting of graphs for better understanding.

Similarly, Michael Allan (2015) who in his study to explore the use of graphical representation as reasoning tools in transferring content knowledge through source processing, the result shows that active representation of graph is powerful tool in problem solving skills of students and that the use graph in the instructions improves academic achievement of students in physics and student's competency in graphical representation. Fernandez (2012) in his study to present common students conceptions and misconceptions about graph arrived at the outcome of the result which shows that students taught using graphs acquires more knowledge of the theory under study and can derive relationship of quantities. Hristing, (2016) also concluded in his study that the formation and development of student's graphical skills, formation of generalized knowledge of graphical method of solving Physics problems, increases the level of students' graphical literacy and academic achievement in Physics. Esu, et. al. (2009) also agrees with this study and that of Nja and Idiege on the effectiveness of using Excel software in plotting graphs.

Conclusion/ Recommendations

Using Excel computer software in plotting graph as an instructional resource enhanced better understanding of some physics concepts with a corresponding increased in academic achievement in Physics compared to the conventional graph book method of teaching. The use of Excel computer software is more effective and efficient in the teaching of graph plotting of some Physics topics in secondary schools. Based on the findings it was recommended that;

i. Teachers should adopt the use of Excel computer software in plotting graphs and computation of equations data in the teaching of Physics.
ii. Government should sponsor teachers' training in ICT knowledge and approval of the Excel computer software in Physics classes.

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