



EFFECT OF COMPUTER SIMULATIONS PACKAGE ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN PHYSICS IN ANAMBRA STATE

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Abstract

This study investigated the effect of Computer Simulation Package (CSP) on academic achievement of students in physics. The research design was quasi experimental research design, specifically, non-equivalent control group. The sample consisted of 65 senior secondary school two (SSII) students which is made up of 50 experimental group (28 males and 22 females) while control group was 15 students (2 males and 13 females) drawn from two co-educational secondary schools in Awka Education Zone of Anambra State. Instrument used for data collection was Physics Achievement Test (PAT) which was validated by physics education lecturers from science education department and pilot-tested in another zone. Scores obtained from pre-test and post-test were used to estimate the instrument reliability and its reliability co-efficient was found to be 0.88 using Kuder Richardson formula 20. The hypotheses were tested at 0.05 level of significance using ANCOVA. The result revealed that computer simulation was more effective in enhancing students' academic achievement in physics than lecture method; there was no significant difference on students' academic achievement due to gender. It was recommended that computer simulation package should be adopted for teaching physics concepts. Based on the findings, it was concluded that computer simulation should be employed in physics teaching in order to improve the students' academic achievement and increase their retention capacity and also the government and education stakeholders should encourage the use of computer simulation package in teaching physics in secondary schools.

Keywords: Academic Achievement, Computer Simulation Package, Lecture Method, Physics

Introduction

Physics is a unique subject that promotes the acquisition of specialized science skills and knowledge that explains the natural phenomena of life in society (Adeyome, 2020). It is a subject that evolved with civilization as man's quantitative needs increased, thus contributing to science and the development of civilization. Okoye et al. (2024) asserted that students acquire the knowledge and skills of Physics to understand how and why natural things happen the way they do, to make predictions and venture into unknown areas of knowledge, and more importantly, to use the knowledge and skills to design and make new development. Similarly, physics studies events in the universe, the motion and energy, the matter, the motion, the cause, effect, and relationship of matter and energy to the application of natural phenomena. Physics



generates fundamental knowledge needed for the future technological advancement that will continue to drive the economic engine of the world. This is to say that inappropriate teaching methods adopted has the ability to influence the learning outcomes of students in a given classroom experience. The power of teaching method in the hand of a teacher cannot be overemphasized. Any teaching method that does not encourage interaction between the teacher and the students is incomplete (Muokwe and Okeke, 2021). Traditionally, many teachers apply teacher centred method to transfer knowledge to the learners as compared to the learner centred method (Akama, 2015). One method of teaching that is commonly used by secondary school teachers is Lecture.

Traditional talk-chalk method of teaching that is the teacher does the talking while students serve as receivers only by listening and taking down notes. Obeka (2020), described lecture method as a teacher-centred method that enhances acquisition of subject matter predominantly under the memorization and close supervision of the students by the teacher. Lecture method is one of the traditional teaching methods that encourages rote learning and registration of information without necessarily facilitating understanding, and this does not enhance academic achievements in science (Usman, 2018). Although this method has few advantages like the teacher covering the scheme of work in a stipulated time, used for a large gathering, quick and straight-forward way of teaching, etc. and some disadvantages like teachers doing the talking and the students listening, the students being passive in the teaching - learning process, little check of students' understanding, and so on, and this may be why most teachers often use it.

In traditional teaching methods, the teacher is the central focus, who talks to passive students and this does not promote meaningful learning nor does it foster critical thinking and students' participation in the teaching and learning process (Njoku, 2018; Ada, 2017). Therefore, it requires the use of various methods and techniques utilizing technological tools in education to facilitate and make sense of in-class teaching and to arouse the curiosity and interest of the students. The simulation technique is one of these methods that have become indispensable for today's technologies and can be used together with technology as part of computer-aided education. This method, which is widely used in educational settings in many countries, offers important opportunities to convey to the student several phenomena that are difficult or even impossible to explain and observe due to various reasons There is a need to make sure that physics is properly taught especially the difficult concepts in physics using innovative methods such as computer-assisted instructional strategies. This aligns with the



finding of Adegboyega & Adeoluwa (2020) that below average performance of students could be attributed to the way they were taught.

Computer Assisted Instructional Strategies (CAIS) are strategies which employ computers to provide instructional contents and allow for interaction between user and computer with immediate feedback (Seo and Bryant, 2019). CAI strategies use tutorials, drill and practice, simulation and problem-solving approaches to present topics and they test student's understanding. Simulation is one of the computer-assisted instructional strategies that that creates animated, interactive, game-like environments, which focus on connecting real-life phenomena to the underlying science. Simulation is a type of technology by which theoretical knowledge is transformed into practice, simplifies the difficult-to-be-comprehended, make the abstract activities to appear real and can reach a solution in a short time (Atalan and Donmez, 2019). A simulation is a form of experiential learning and as a result, it can be said that simulation technique, which is a student-centered approach, makes learning apprehensible and facilitates permanent learning by structuring the knowledge (Çinici et al., 2013). It is a strategy that fits well with the principles of student-centered and constructivist learning and teaching. Simulations take a number of forms. They may contain elements of a game, a role-play, or an activity that acts as a metaphor.

Simulations are characterized by their non-linear nature and by then controlled ambiguity within which students must make decisions. Within this process, it makes the visual and conceptual models of experts and scientists simple so that they can be understood by learners (Adams, 2018). In addition, simulations can use strategies effective for supporting students' learning about the task. The inclusion of simulations in education programs has many contributions like improving the quality of education by ensuring the active participation of the student in the course and sustaining student's retention thereby leading to a better academic achievement in the subject of physics (Sarı and Güven, 2013; Şahan, 2019). Therefore, including simulations in education programs as a complementary and augmentation tool can contribute to achieving effective, sensible, and permanent learning. Similarly, the studies also revealed several challenges and limitations of the simulations together with the educational opportunities they offer in many aspects. In particular, the reasons such as the difficulty in the cost of designing a software during its development, the time required to develop software suitable for each acquisition, and then in selecting and applying a model identical to reality are among the problems that prevent the use of simulations software packages in education (Aykaç, 2014). Furthermore, as the system becomes more complicated, the simulation model



developed is also adversely affected in terms of time and cost factors (Koç-Ünal, 2019). Simulation tools are easily affected by power outages and user errors, and they can get out of order or even break down (Bıçak, 2019). On the other hand, the facts that it is possible to encounter situations in real life that are not encountered in its simulation, that it does not always yield definite results, that it is simplified because it is artificial, and that it partially distorts the truth can be expressed as other important issues (Şahan, 2019). It can be stated that these problems must be eliminated to obtain the desired effect from simulation-based applications.

Academic achievement is the result of what an individual has learned from some educational experiences. It connotes performance in school subject as symbolized by a score or mark on an achievement test (Okoye & Nwuba, 2024). Academic achievement is the result of what an individual has learned from some educational experiences. It refers to an academic position a student occupies in the class relative to the position of others in the class usually assessed by the teacher's use of rating scales, tests and examinations (Anekwe, 2011). Ricarda *et.al* (2017) further explained that academic achievement is the benchmark of academic progress as it helps educational bodies monitor students in schools and make changes in the educational system where necessary, as it prepares them for the future. Academic achievement is defined as the gain in knowledge of a student which occurs as result of taking part in a learning activity or programme and will be ascertained in the study using Physics Achievement Test (PAT). Therefore, research findings have shown contradictory evidence in achievement and interest of students in physics influenced by gender.

Gender refers to the socially constructed characteristics of men and women such as norms, roles, and relationships of sexual nature. According to Anyigor et al. (2025), gender disparity in education especially in science courses is a worldwide phenomenon. Calsmith (2017) had explained that the influence of gender and differences in academic achievement was a complex task, thus many studies appeared to be contradictory. Nigerians generally uphold that males are superior to females in terms of physique, cognition, logical reasoning and evening in academic reasoning (Anigbogu in Okafor, 2016). Almasri (2022) found that e-learning favoured both male and female students in terms of achievement and interest in Physics. These studies evidenced that some teaching methods close the gender gap in science achievement, worthy of note is that both male and female are attracted to digital processes.



Statement of the Problem

Physics is a science subject that is fundamental for developments in any country. The academic achievement of the students in physics has seriously assumed a negative dimension over the years in Nigeria. The Chief Examiners Reports have showed that students experience difficulty in answering questions from some physics concepts. According to the reports, the candidates' weaknesses among others are poor knowledge of concept of motion, poor mathematical skills in calculating vectors, differentiating electrical current from magnetic current, the principle involved in transformer. The concern about the academic achievement of students in physics has led some scholars and researchers to embark on some researches but unfortunately their findings pointed out to abstract nature of physics concepts, exposure to only theoretical aspects of physics and inappropriate teaching methods as the major causes of students' poor academic achievement in physics and this makes students at school to stay away from physics or another subject related to physics, either directly or indirectly, because the students find this subject to be dreadful and difficult to study. This problem started in the classrooms, which still practice conventional teaching methods and lack exposure to the use of modern teaching and learning in line with the 21st century. Physics, being an activity-oriented subject should be taught experimentally using innovative teaching methods but unfortunately the apparatuses are insufficient and somehow unavailable and conventional teaching methods are still employed. Such experiments can be demonstrated and viewed in a classroom capable of displaying videos and to the best of the researcher's knowledge, no such study has been carried out in the area of vectors. The present study is set to fill the gap.

Hypotheses

Based on the above, three null hypotheses were formulated.

- Ho1** There is no significant difference between the mean achievement scores of SSII students taught physics using CSP and those taught using Lecture method.
- Ho2** There is no significant difference between the mean achievement scores of male and female students taught physics using CSP.
- Ho3** There is no interaction effect of gender and teaching methods on the mean achievement scores of students in Physics.

Methods

The study adopted a quasi-experimental, non-equivalent control group design. The study was carried out in Njikoka Local Government Area in Awka Education Zone of Anambra state, Nigeria. Anambra State is one of the 36 states of Nigeria and is located in the South-



eastern part of the country. The inhabitants are mainly civil servants and traders. The population of the study consists of all Senior Secondary Two (SS2) physics students in seven (7) public co-educational Secondary Schools in Njikoka Local Government Area of Awka Education Zone of Anambra state numbering 691 students (236 females and 435 males) enrolled for 2022/2023 academic session.

The sample consists of sixty-five (65) SS2 students drawn from two schools out of the 7 co-educational secondary schools in the study area. The two schools were drawn purposively out of 7 schools because they have computer facilities. By flip of coin, one school was assigned experimental group and the other control group. Data were collected using an instrument tagged Physics Achievement Test (PAT). Face and content validity of PAT were established by physics education lecturers from science education using table of specification in which questions were distributed among three bloom taxonomy namely knowledge, comprehension and application. Reliability of the CAT was established using Kuder Richardson 20 (KR- 20) because the items were dichotomously scored and this yielded a coefficient of 0.88. PAT has a total of 25 multiple choice questions on magnetic current. Students were given pre-test after which they were subjected to treatment which lasted for four weeks and then the administration of a post-test. The data collected were analyzed using both descriptive and inferential statistics. The general questions were answered using descriptive statistics while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Results

Table 1: ANCOVA Analysis of Students taught with CSP and Those Taught Using Lecture Method in Physics

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	23535.809 ^a	4	5883.952	27.203	.000	
Intercept	14741.350	1	14741.350	68.152	.000	
Pretest	3334.812	1	3334.812	15.417	.000	
Method	8931.598	1	8931.598	41.293	.000	Sig
Gender	403.113	1	403.113	1.864	.177	
method *gender	851.912	1	851.912	3.939	.052	Not. Sig.
Error	12978.037	60	216.301			
Total	325625.000	65				
Corrected Total	36513.846	64				

a. R Squared = .645 (Adjusted R Squared = .621)

The result on Table 1 also showed that an F-cal of 41.293 with associated probability value of .000 was obtained with respect to the difference in the mean achievement scores of students` taught Physics using Computer Simulation Package and those taught with Lecture



Method. Since the associated probability (.000) was less than 0.05 level of significance set as the criterion for taking a decision, the null hypothesis (H_{01}) was rejected. It was therefore concluded that there is a significant difference in the mean achievement scores of students taught Physics using Computer Simulation Package and those taught with Lecture Method.

Table 2: ANCOVA Analysis of Students taught with CSP in Physics as Moderated by Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	23535.809 ^a	4	5883.952	27.203	.000	
Intercept	14741.350	1	14741.350	68.152	.000	
Pretest	3334.812	1	3334.812	15.417	.000	
Method	8931.598	1	8931.598	41.293	.000	
Gender	403.113	1	403.113	1.864	.177	Not. Sig
method *gender	851.912	1	851.912	3.939	.052	
Error	12978.037	60	216.301			
Total	325625.000	65				
Corrected Total	36513.846	64				

a. R Squared = .645 (Adjusted R Squared = .621)

The result on Table 2 showed that an F-cal of 1.884 with associated probability value of .177 was obtained with respect to the difference in the mean achievement scores of male and female students taught Physics using Computer Simulation Package. Since the associated probability (.177) was greater than 0.05 set as the level of significance and criterion for taking a decision, the null hypothesis (H_{02}) was accepted. Based on this, it was therefore concluded that there is no significant difference in the mean achievement scores of male and female students taught Physics using Computer Simulation Package. This result also shows that Computer Simulation Package did not discriminate between male and female students when it comes to its application in teaching physics concepts so as to increase students` achievement.

The result in Table 1 shows that an F-cal of 3.939 with associated probability value of .052 was obtained with respect to the interaction effect of gender and method on students` achievement scores in Physics. Since the associated probability (.052) was greater than 0.05 level of significance set as the criterion for taking a decision, the null hypothesis (H_{03}) was accepted and that shows no significant interaction effect of gender and method on the mean achievement scores of students in Physics.



Discussion

The results favoured the experimental group (computer simulation package) over the control group (lecture method). Computer simulation package allows users to interact with it and minimizes abstractness of physics concepts to the students. Students in experimental group were able to visualize, explore and formulate scientific ideas and theories that were otherwise impossible to observe and manipulate by students in control group. This implies that computer simulation package improves students' achievement more than lecture method. The lecture method is considered ineffective due to the facts that, it creates little impact on learners' academic achievement, because the lesson is dominated by the teacher, talking to the learners while the learners remain passive listeners and recipient of knowledge. There were little or no use of materials by the learners, the learners' level of abilities was not taken into consideration by the teacher. It is believed that use of learner centered approach makes teaching and learning more interesting, make the classroom environment lively, arouse learners interest and sustained their interest and attention throughout the teaching and learning process as a result of involvement of all the learners in the lesson through individual and group work, learners of all abilities get opportunity to think, the teacher focuses on their understanding and not just memorization and recalling of facts (Bukar, Bello & Ibi 2016). This finding concurred with those of Okwuduba, Offiah & Madichie (2018) and Adegboyega & Adeoluwa (2020) that showed better academic achievement when students were exposed to animated and simulation package treatment as against the control group that used conventional method.

The finding indicate that gender had no influence on the mean achievement score of students taught physics using computer simulation package. This finding concurred with Alamasri (2022) that stated both male and female were at an advantage but contradicted the finding of Okeke (2017) which found out that the male counterpart benefitted from this innovative teaching method more than the female showing that the male students performed better than the female students. By implication, computer simulation package did not have significant effect in the mean achievement of male and female students in physics.

The finding also showed that there was no significant difference in the interaction effect of teaching methods and gender in students' achievement in physics. Since both male and female students benefited from the instructional approach, it might help to reduce gender related differences in the study of physics. This means that male and female students had no difference in their achievement from the treatment using Computer Simulation Package as the main effect. This is in line with the finding of Shazli 2017 that stated that there was no



interaction effect of teaching methods and gender on students' achievement in physics. The implication of the study, is that there was no significant interaction effect between teaching methods and gender on mean achievement scores of students in physics.

Conclusion

The study shows that computer simulation package had significant effect on students' overall mean achievements scores of students in physics. The experimental group taught physics with computer simulation package had higher mean achievement scores than the control group taught with lecture method.

Recommendations

Based on the research findings of this study, the following recommendations were made by the researchers.

1. Teachers of physics subject should be encouraged to adopt and improve on their usage of computer simulation package in the classroom to enhance the academic achievement of physics students.
2. Experts in computer science should be involved in the training and retraining of teachers through seminars, workshops and conferences on the usage of computer simulation packages for better students' achievement.

References

- Abdel-Maksoud, N. F. (2019). When virtual becomes better than real: Investigating the impact of a networking simulation on learning and motivation. *International Journal of Education and Practice*, (4), 253-270.
- Adegboyega, S.M & Adeoluwa, O.V (2020). Effects of animated cartoon based instructional strategy on senior secondary school students' learning outcomes in computer studies in Ekiti State, Nigeria. *Journal of Human Kinetics and Health Education*. 3(1), 108 – 121.
- Adeyome, S.A (2020): Background and classroom correlate of students in physics. *International Journal of Educational Research and Technology*, 1, 25-34.
- Almasri, F. (2022). The impact of e-learning, gender-groupings and learning pedagogies in biology undergraduate female and male students' attitudes and achievement. *Education and information technologies*. 27: 8329 -8380
- Anyigor, C.P., Nwuba, I.S., & Osuji, C.C. (2025). Self-regulation ability as a correlate of secondary school students' academic achievement in biology in Anambra State. *UNIZIK Journal of STM Education*, 8(1), 86-96



- Aydođan, A. (2019). *Effect of cooperative teaching method supported by simulation on students' academic success and science attitudes: DNA and genetic code subject* (Unpublished master thesis). Inonu University, Malatya.
- Aykaç, N. (2014). *Öđretim ilke ve yöntemleri*. Ankara: Pegem Press.
- Bıçak, F. (2019). *The effect of using interactive boards enriched with simulations on academic achievement in science: '6th grade force and motion sample'* (Unpublished master thesis). Trabzon University, Trabzon.
- Bukar, I.B, Bello S. & Ibi, M.B, (2016). Role of Computer in Instruction, Assessment and Administrative Delivery of Educational Goals in the University of Maidugri, Nigeria: *Journal of Education and Practice*, 7(20), 81-87
- Kibirige, I., & Tsamago, H. E. (2019). Grade 10 learners' science conceptual development using computer simulations. *EURASIA Journal of Mathematics, Science and Technology Education*, 15(7), 1-17. <https://doi.org/10.29333/ejmste/106057>
- Koç-Ünal, İ. (2019). *Investigation of the effects of virtual and real laboratory applications on the academic achievement of 5th grade science course electric unit teaching* (Unpublished master thesis). Necmettin Erbakan University, Turkey.
- Muokwe, E.O & Okeke, S.O.C (2021): *Effect of Jigsaw Technique on the Academic Achievement and Retention of Secondary School Students in Biology in Awka Education Zone*. Unpublished thesis (M.Sc. Ed). Nnamdi Azikiwe University, Awka.
- Ndegwa, A. W., Ngeno, J. K., & Ndeke, G. C. W. (2023). Effects of simulation teaching technique on achievement of students in physics concepts in Buuri-east sub-county Kenta. *Journal of Education Research in Developing Areas*, 4(1), 65-77. <https://doi.org/10.47434/JEREDA.4.1.2023.65>
- Njoku, Z.C. (2018). Comparison of student's achievement in the three categories of questions in SSCE practical chemistry examination. *Alvan Journal of Science* 8(1), 67-72.
- Obeka, S.S. (2010). Effect of inquiry and demonstration methods on students' achievement, concepts of education. *Journal of Studies in Science and Mathematics Education*, 1(1), 52-58.
- Oche, U.G. (2017). *Curriculum and instruction; General methods and principle of teaching and learning*. Owerri: Global City Publishers.
- Okoye, N.T., & Nwuba, I.S. (2024). Probing computer-assisted instructional effect on academic achievement of secondary school students' in Physics. *Journal Plus Education*, 36(2), 272-284.
- Okoye, N. T., Nwoye, A.N., & Nwuba, I.S. (2024). Impact of Technology enhanced learning on academic performance of high school students in Physics in Anambra State. *Asian Journal of Interdisciplinary Research*, 7(4), 12-28.



- Okwuduba, E. N, Offiah, F.C & Madichie, C.J (2018). Effect of computer simulations on senior secondary students' achievement I chemistry in Anambra State. *Asian Journal of Education and Training* 4(4), 284-289.
- Şahan, C. (2019). *Examination on the effect of disaster and earthquake education given by using simulation method on secondary school students in disaster education center* (Unpublished master thesis). Canakkale Onsekiz Mart University, Çanakkale.
- Sarı, U., & Güven, G. B. (2013). The effect of interactive whiteboard supported inquiry-based learning on achievement and motivation in physics and views of prospective teachers toward the instruction. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, 7(2), 110-143. <https://doi.org/10.12973/nefmed204>
- Seo, Y. & Bryant, P. (2019). *Analysis of Studies of the Effect of Computer Assisted Instruction on the Mathematics Performance of Students with Learning Disabilities*. *Computer & Education*. 53, 913- 928.
- Usman, K.O. (2018). Effects of ethno mathematics teaching approach on students' interest and achievement in locus. *Benue Journal of Research in Science Education*. 1(1), 81-91.
- Yıldız, M. (2019). *The effect of teaching about buoyancy force with simulation technique on students achievements* (Unpublished master thesis). Suleyman Demirel University, Isparta.