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IMPACT OF COMPUTER SIMULATION PACKAGE ON SCIENCE STUDENTS' ATTITUDE IN SENIOR SECONDARY SCHOOLS IN EKITI STATE, NIGERIA

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Abstract

The study determines the impact of computer simulation package on attitude of senior secondary school students in some science concepts. Abstract scientific concepts on pollution and energy were simulated and animated. Six hundred class two students randomly sampled from twelve co-educational secondary schools out of Two hundred and twenty (220) Government owned secondary schools in Ekiti State constituted the sample using multi-stage purposive and simple random sampling techniques. One validated instrument: Students' Attitude Questionnaire (SAQ) having twenty five items was administered to the respondents to generate data that answered the research questions and tested two hypotheses at 0.05 level of significance. Data collected were analysed using analysis of Covariance (ANCOVA). The finding shows that the developed computer simulation package has positive impact on students' attitude towards the learning of science concepts (F_{-cal} 1049.01 = P < 0.05), while school location showed no significant influence on both the experimental and control group (F_{-cal}1.03 =P=0.312>0.05) at 0.05 level of significance. It was therefore recommended by the researchers that teachers of science subjects should be encouraged to develop and use simulation packages in the classroom and experts in simulation designs should train and retrain science teachers. Curriculum planners should incorporate package designs and usage in the school curriculum.

Keywords: Impact, Computer Simulation, Students' Attitude, Science Concepts.

INTRODUCTION

While computer simulation is becoming more transparent in the field of science, science education is a fundamental area to the technological advancement of developing countries (Murshed, 2023; Wang, He, & Song, 2021). The way science is taught can make a difference in what a nation becomes – developed, developing or underdeveloped. For any nation to attain self-reliance, science must be an important component of the knowledge to be given to her citizens irrespective of tribe/ethnicity, creed or gender (Ezenwa, 2011). The present situation in Nigeria, in which there is low enrolment in science subjects by learners may not be unconnected with the exposure of students to poor methods of teaching (Alake & Olojo, 2020; Aladejana, 2006). Generally, teaching in Nigeria still retains the old conservative approach of teachers acting as repertoire of knowledge and students acting as the dormant recipients (Aladejana & Idowu, 2006). This traditional teacher-centered learning approach often does favours passive reception of knowledge but focuses on mastery of content, with less emphasis on the development of skills and the nurturing of inquiring attitudes (Alam, 2023; Emaliana, 2017; Serin, 2018; Sahin, 2006;**).** On the other hand, interactive technology encourages active learning, hence teaching should no longer be centred on transfer of content from teacher to

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students but rather a learner-centred (Olugbenga, 2021; Darsih. 2018; López, Esteban, Mateo, Peleato, & Rodríguez, 2015).).

Simulation is the manipulation of model in such a way that it operates on time or space, thus enabling one to perceive the interactions that would not otherwise be operant (Okwuduba, Offiah, & Madichie, (2018). Simulation involves creating a system, to real world and thus teaches the learner about the world in process (Çelik, 2021). The system is imitated (Okwuduba et al., 2018). Fletcher-Flinn & Gravatt (1995) submit that simulation always have specific goal in mind to mimic a real system so that students can explore it, perform it before implementing it in the real world. Various simulation packages as applied to training and education can be traced to the works of Ivers & Barron (1998). Johnstone (2007,) on the other hand, views simulation as a powerful technique that teaches some aspects of the world by imitating or replicating it (Jones, & Barrett, 2017; Sahin, 2006). Students are not only motivated by simulations but they learn by interacting with them in a manner similar to the way they would interact with the real situations (Saputri, 2021). It therefore simplifies reality, enhances students' problem solving skills and teaches procedures that come out with understanding of the phenomena and how to control them at different situations. Moreover the world is a global village that encourages use of technological gadgets which calls for a new reform in the teaching and learning process. Some researchers are of the opinion that computer simulation can be used to enhance students' interest resulting in positive attitude towards science concepts (Amaechi, Chinwe & Udogu, 2008; Chen & Howard 2010; Cheung, Slavin, Kim, & Lake 2016; Jongur, Mohammed & Abba, 2008). Although this study focuses on secondary schools, the complexity in higher education teaching and learning processes call for computer simulation experience. It was argued that "simulations are among the most effective means to facilitate learning of complex skills across domains" (Chernikova, Heitzmann, Stadler, Holzberger, Seidel & Fischer, 2020. p.499)

Although the classification of computer simulation in science is not conclusive, exhaustive and none unique, Duran (2017) listed three types of computer simulation. These comprise the agent-based simulations, cellular automaton, and equation-based simulations. These classifications highlighted by Duran (2017) was ensured by the enormous discussions in the computer scholarly writing (Duran (2017). For example, Duran (2017, p.20) argues that

> "Cellular automata are simple forms of computer simulations. Such simplicity stems from both, their programming and underlying conceptualization. A standard cellular automaton is an abstract mathematical system where space and time are considered to be discrete; it consists of a regular grid of cells, each of which can be in any state at a given time. Typically all the cells are governed by the same rule, which describes how the state of a cell at a given time is determined by the states of itself and its neighbours at the preceding moment"

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It is noted that there are software useful in computer simulation in the teaching of science courses. The most commonly used by teachers was developed by the University of Colarado named, PhET for science education (Daskan & Yildiz, 2020; Çelik, 2021). PhET simulations designed was designed simple for users. Specifically, in Nigeria, the use of computer is being felt in the areas of administration, research, publishing and so on, but not much of its use is in operation in the area of teaching and learning in secondary schools (Develaki, 2019**)**. Effective and meaningful teaching of science concepts requires active students' involvement in the teaching-learning process (Siswanto et al., 2018). The inadequate and obsolete teaching and learning facilities used today militate against positive attitude and resulting in poor performance (Oloruntegbe & Alake, 2010). Science subjects are often regarded as difficult; an observation that sometimes repels learners from continuing with studies in sciences in higher institutions as opined by Kehinde (2000) and Alake (2024). They further reported that concepts like mole, chemical formulae among others are perceived difficult by students. Some of the problems which further hinder active involvement of students include abstract nature of the concept, inability to get the real objects and complexity in making use of the real object even when it is available. There is therefore, the need to find substitutes for these real objects. Hence, the research work developed a computer simulation package and determined its impact on secondary school students' attitude towards science (Duran, 2017).

Purpose of the Study

The purpose of the study was to determine the impact of the developed simulation package on senior secondary school students' attitude towards science concepts. Specifically, the influence of students' school location towards the computer simulation packages was also determined.

Research Questions

The following questions were raised and answered in the research.

(1) Would the treatment produce better attitude of students towards the learning of science subjects?

(2) What is the impact of the treatment on school location of students' attitudes towards science subjects?

Research Hypotheses

The following null hypotheses were tested in the study.

$H0_1$: There is no significant difference in the attitude of students exposed to the developed computer simulation package and their counterparts who were not.

$H0_2$: There is no significant difference in the attitude of urban science students taught with the developed computer simulation package and their rural counterparts.

METHODOLOGY

This study adopted quasi-experimental design using pre-test and post-test control and experimental groups. The population of the study consisted of all senior secondary school class

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II (SSII) science students in the 220 government owned senior secondary schools in Ekiti State. The sample for the study consisted of 600 senior secondary school class two (SSII) students, selected using multi-stage random sampling technique. At the first stage, random sampling was made according to the three senatorial districts in Ekiti State. A total of twelve co-educational senior secondary schools (four schools per senatorial district) were selected using purposive random sampling technique. Fifty (50) students were thereafter randomly selected from each of the participating schools.

From each senatorial district, two schools were later randomly assigned to each of the two groups (experimental and control groups). Thus, one hundred (100) students were randomly assigned to each of the experimental and control groups in each senatorial district, i.e. three hundred (300) students were each used for experimental and control groups in the research. The instructional package for the study consisted of the Computer Simulation package and the teaching manual on energy and pollution developed and validated by the researcher. The instructional package for the study consisted of a computer learning package tagged 'Computer Simulation Package and students' attitude that covered abstract scientific concepts from three major science subjects (Biology, Chemistry and Physics). Concepts were simulated and animated to bring their realities. Pictures and voices were added where necessary to make the concepts real. Specifically, the package covered topics from senior secondary class two science curricula in the areas of pollution and energy.

A set of instrument was used by the researchers; namely Students' Attitude Questionnaire (SAQ) to collect relevant data for the study. The second instrument SAQ is a Mathematics Attitudinal Scale adapted from Aborisade (2007) in Olojo (2011). This questionnaire consisted of two sections A and B. Section a elicited information on personal data of the respondents, while section B contained a twenty-five (25) items seeking information on students' attitude towards the learning of scientific concepts. A four point Likert scale ranging from strongly agree to agree, disagree to strongly disagree coded 4, 3, 2 and 1, vice versa for correct negative response was used to score each item respectively and was validated using Alpha Cronbach estimate of 0.85 value. Data collected were analysed using descriptive and inferential statistics. The general questions were answered using descriptive statistics while ANCOVA was used to test the hypotheses at 0.05 level of significance.

Questions 1

Would the treatment produce better attitude of students towards the learning of Science?

Table 1: Pre-test and Post-test mean scores and Standard Deviation of Students' Attitude towards Science concepts.

		Pre-test		Post-test	
Variable	N	Mean	SD	Mean	SD
Experimental	300	44.92	9.08	74.80	4.52
Control	300	44.07	6.25	48.50	13.30

Source: Author's Computation

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Table 1 shows that experimental group has a mean score of 44.92 while the control group has a mean score of 44.07 with a mean difference score of 0.85 in pre-test. This reveals that students in the control group show positive attitude towards science than their counterparts who were in the experimental group. In post-test, the experimental group has a mean score of 74.80 while the control group has a mean score of 48.50 with a mean difference of 36.29.

Question 2

What is the impact of the treatment on school location of students' attitude towards science subjects?

Table 2: Pre-test and Post-test means scores and Standard Deviation of urban and rural students' attitude towards science subjects.

	Male					Female				
	Pre-test			Post-test		Pre-test			Post-test	
	N	Mean	SD	Mean	SD	N	Mean	SD	Mean	SD
Experimental	300	44.78	9.67	74.98	4.66	300	45.04	8.62	74.66	4.42
Control	300	43.73	6.38	48.51	14.22	300	44.32	6.16	48.52	12.74

Source: Author's Computation

Table 2 shows that male students in experimental group have a mean attitude score of 44.78 in pre-test and a mean attitude score of 74.98 in post-test with a mean score difference of 30.20. In control group, male students have a mean attitude score of 43.73 in pre-test and a mean attitude score of 48.51 in post-test with a mean score difference of 4.78. Comparing the two mean score differences, experimental group and control group have 30.20 and 4.78 mean score respectively.

The table also shows that female students in experimental group had a mean attitude score of 45.04 in pre-test and a mean attitude score of 74.66 in post-test with a mean score difference of 29.62. While female students in control group have a mean attitude score of 44.32 in pre-test and mean attitude score of 48.52 in post-test with a mean score difference of 2.20. This indicated that male students in experimental group show more positive attitude towards the learning of scientific concepts than their Female counterparts.

Table: 3 Summary of ANCOVA of Students' attitude by treatment

Source	SS	Df	MS	F_{cal}	P
Corrected Model	104124.24	2	52562.12	540.59	0.000
Covariate (pre-test)	1475.91	1	1475.91	15.18	0.000
Group	101996.76	1	101996.76	1049.01	0.000
Error	58047.03	597	7.23		
Corrected total	163171.27	599			
Total	2444098.00	607			

P <0.05

Note: SS= Sum of Square, Df = Degree of freedom

Source: Author's Computation

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Table 3 shows that F_{-cal} 1049.01 = P<0.05 is significant which led to none upholding of the null hypothesis. This indicates that significant difference exits between the attitudes of students exposed to treatment (Experimental group) and those who were not exposed to the treatment (Control group) in the sciences. Hence, Multiple Classification Analysis was applied as indicated in the table below.

Table 4: Summary of Multiple classifications of students' attitude mean scores by treatment.

Grand Mean = 61.66

Variable + Category	N	Unadjusted Deviation			
			? ta	Adjusted for independent+ Covariance	Beta
Experimental	300	13.14	0.29	13.02	0.14
Control	300	-13.15		-13.02	
Multiple R^2					0.11
Multiple R					0.13

Source: Author's Computation

Table 4 shows that the adjusted mean scores of experimental groups is 74.68 (61.66 + 13.02) and that of control group is 48.64 (61.66 + (-13.02). This implies that adjusted mean of 74.68 in experimental group was greater than that of control group of 48.64. Hence, the treatment exhibited an impact on the attitude of experimental groups based on the mean scores difference of 26.24. The co-efficient of determination is 0.11, while the multiple correlation coefficient is 0.13. This reveals a very low and positive relationship between the control and experimental groups as indicated in table 4. Thus, there is a wide difference between the attitude of experimental groups and control groups in sciences.

Table 5: Summary of 2 x 2 ANCOVA showing interaction impact of Gender and treatment on students' attitude towards Sciences.

Source	SS	Df	MS	F_{cal}	P
Corrected Model	105135.02	4	26283.76	269.49	0.00
Covariate (pre-test)	1479.39	1	1479.39	15.17	0.00
Sex	8.33	1	8.33	0.09	0.77
Group	106181.13	1	100181.13	1027.08	0.00
Sex Group	2.42	1	2.42	0.03	0.88
Error	58036.25	595	97.54		
Corrected Total	163171.27	599			
Total	244098.00	600			

Note: P<0.05, N = Sample SD = Standard deviation

Source: Author's computation

Table 5 shows that no interaction impact of gender and treatment on students attitude toward the learning of sciences at F_{cal} (0.03), df(1), and P(0.88) which implies that F_{cal} (0.03) was less at P<0.05. Therefore, the null hypothesis is upheld which indicates that both male and female

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students exposed to the same treatment shows no significant difference in their attitude toward the learning of sciences.

DISCUSSION OF FINDINGS

The study revealed the impact of treatment (Computer Simulation Package) on the students' attitude towards science concepts. The result in table 1 shows that the treatment (CSP) influenced the attitude of students in science as indicate in the post-test mean scores which implied that the treatment has improved the attitude of students toward learning of sciences. This is supported by Akhigbe and Ogufere (2019) who opined that exposure of students to computer simulation instructional strategy has potentials in fostering students' learning of abstract and difficult concepts in biology. As agreed by the works of Ugur, Abdillahi, Kutalmis and Omer (2017) that interactive simulations integrated 5E teaching model caused significantly better acquisition of scientific concepts and relatively higher positive attitude towards physics than traditionally based instruction.

The result is also in line with the findings of Snowman (1995), Fletcher-Flinn and Gravatt (1995), Lowe (2001) and Olojo (2011). This makes the learning of science concepts more meaningful and abstract concepts simplified by the use of animation. The result from table 2 shows a positive impact of the treatment (CSP) on gender of students' on the attitude of female students towards the learning of sciences than their male counterpart as shown in the table. This finding is however in disagreement with the findings of Watt (1981), Zakariya (1982), Becker (1982), Lioyd & Gressard (1984), Winkle and Matthew (1992) and Yamanka & Jack (1995) who reported that, when measuring women's attitude and literacy toward computer and advanced technology, females apparently felt that males are more knowledgeable about today's technology.

Table 5 reveals no significant differences between the attitude of male and female students in experimental group and control group toward the learning of sciences among the Senior Secondary (SSII) in Ekiti State. This result is at variance with the findings of Roberts & Madhere (1990), Ravaglia, Suppes, Stillinger & Alper (1995) and Brophy (1999) who found out in their researches that computer assisted instruction (CAI) was effective in Science classroom settings.

CONCLUSION

The study vividly shows that development and usage of computer simulation package influence the attitude of students in sciences positively because significant differences exist between the mean attitude of students in experimental and control groups after the usage of computer simulation package. Whereas, gender has no significant influence on students' attitude in both experimental and control groups in the learning of science concepts in Ekiti State senior secondary school class two.

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RECOMMENDATIONS

This study recommends the following based on the findings.

1. Science subject teachers should be encouraged to use computer packages in the classroom since the usage aroused students' attitude towards the learning of science positively.
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 instructions.
3. Computer simulation packages should be incorporated in senior secondary school curriculum by curriculum planners and stakeholders.
4. The required support and resources needed by teachers to incorporate the usage of computer packages should be given by both the government and school managers.

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Conflict of Interest

The authors of this article have no conflict of interest to disclose

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