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EFFECTS OF COMPUTER SIMULATION MODEL ON SECONDARY SCHOOL STUDENTS' UNDERSTANDING OF THE PARTICULATE NATURE OF MATTER

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ABSTRACT

This study investigated the effects of computer simulation model on secondary school students' understanding of the particulate nature of matter. Four research questions and four hypotheses guided the study The study adopted the pre – test, post – test control group quasi – experimental design. Forty – two thousand, eight hundred and eight students made up the population for this study. Two hundred and thirty-six SS II students were the sample for this study. The sampled schools were selected using simple random sampling technique. Scholastic Ability Test in Chemistry (SATIC) and Chemistry Achievement Test (CAT) were the instruments used for data collection. CAT has a reliability coefficient value of 0.77 obtained using Kuder Richardson formula 21. The data obtained was analyzed using mean, standard deviation, t-test and analysis of variance (ANOVA). The result of the study showed that: students taught Chemistry with computer simulation performed significantly better than their counterparts taught with lecture method; there was no significant difference in the performance of male and female students taught chemistry with computer simulation model; there was a significant difference in the mean retention scores of students taught chemistry using computer simulation model and those taught with lecture method, in favour of computer simulation model; there was no significant effect of interaction of sex and ability on students' achievement in chemistry; there was no significant effect of interaction of sex and teaching method (computer simulation model and lecture method) on students' retention of chemistry. The study further found that there was no significant effect of interaction among method, sex and ability on students' retention towards chemistry. The study recommends that chemistry teachers should adopt the use of computer simulation model in teaching chemistry at the secondary school level; to enhance students' active participation and interaction of chemistry concept.

Key words: Computer simulation model, secondary school students, particulate nature, matter.

INTRODUCTION

Chemistry, a physical science that studies the properties and interactions of matter and energy, contributes to the understanding and description of our universe. Chemistry makes it possible to investigate the properties, characteristics, and physical and chemical changes of matter. Chemistry, according to Ababio (2016), is the study of the qualities, applications, and composition of matter. investigates how matter changes, searching for the underlying principles that govern this action. When something has mass and occupies space, it is said to be matter. The term "particulate matter" merely denotes the fact that everything is composed of microscopic particles. This basically means that there are vacant spaces between different objects. Almost every part of chemistry is impacted by the microscopic nature of matter. The cornerstone for these ideas is the particle theory, often known as the kinetic molecular theory, which provides explanations for many aspects of solution chemistry (Harrison and Treagust, 2000).

The particle nature of matter, according to many academics (Ozmen, 2011; Taber, 2001; Adbo and Taber, 2009), is crucial for students' long-term success in studying chemistry. One of the cornerstones of chemistry education is the idea that matter is made up of particles. Students comprehend particle-based models of matter at a lower level than they do other models (Othman, Treagust and Chandrasegaran, 2008). It is impossible to exaggerate how crucial chemistry education is in ensuring that students are equipped to meet human needs for food, healthcare, and other necessities by giving them the knowledge and skills they require to be successful in their employment. A solid foundation in chemistry education is necessary for the development of a country's chemical sector (Emendu, 2014). Chemists Akajagbor and Oni (2011) assert that the following measures demonstrate how chemistry has contributed significantly to country development over time.

Education in chemistry is essential to technological innovation, since new and improved techniques of manufacturing are found via chemical investigations. In addition, chemistry excites and motivates, as well as widening one's interest in the subject. In addition, chemistry frees the human mind from the shackles of ignorance and superstition and encourages him to embrace new experiences.

Income Allocation: Equity, quick national development, social and political stability all depend on a fair and efficient distribution of income. These can only be realized if chemistry plays a role in redistribution of wealth, not in bridging the gap between the affluent and the poor. Chemistry's contribution to national progress cannot be overstated.

Students learn about the effects of pollution and dangerous chemicals in the world via chemistry in school. Engineering, agriculture, pharmacy, medicine, and petrochemical industries all rely on chemistry. Due to the critical role chemistry plays in the agriculture and industrial sectors, secondary school students are required to take chemistry courses. Chemistry instruction in

secondary schools should aim to teach students the following skills, according to the National Education Policy (FRN, 2014).

The Nigerian National Policy on Science and Technology Education (FRN, 2018) supports these aims and objectives. Promoting Science and technology education for scientific and technological excellence to be facilitated to build frameworks for inter-institutional cooperation in the development of science and technology education programs in all areas of the economy; creating the circumstances for the strengthening of the scientific and technical infrastructure for research, development and innovation in our educational industries; and, the Nigerian economy's efforts for global competitiveness must be supported by science and technology education program goods

Chemistry students' performance in External Examinations has drawn the attention of stakeholders in the educational industry since it doesn't justify the significant investment in the field by both government and commercial sector (Shehu, Oni, Adeyinka and Omega, 2013). Students in impoverished nations do poorly in chemistry, according to Ogunniyi (2001). Parental and stakeholder concerns have been raised due to the students' low performance in Chemistry. The method used to teach chemistry might be a component in the problem. A student's performance in Chemistry might be harmed if the teacher's approach isn't appropriate for the student's level. It is necessary to move away from traditional lecture methods and toward more student-centered ones in order to enhance the instruction of particulate nature of matter. Accordingly, a student-centered instructional technique, such as computer simulation, will be used by the researcher to test its efficacy.

Results-oriented concept, academic accomplishment measures the degree to which a student has achieved their goals (Rix, 2010). We define students' academic success in terms of their ability to read and comprehend literary works, as measured by standardized examinations administered by their instructors. School grades should be based on academic accomplishment since it includes information on scholastic performance over a long period of time and from many sources, such as attendance in courses or written exams, according to Roth, Hecker, Romevke, Schafer; Dominic and Spinath (2015). The academic quality of secondary schools has significantly deteriorated in comparison to what the general public expects (Ogunsaju, 2004). Many secondary school instructors in Nigeria adopt the lecture style of teaching, which results in passive learners who learn by memorization and repetition of information, resulting in low academic accomplishment and retention (Irinoye, Bamidele, Adetunji and Awodele, 2015; Ajaja,2013). Students' performance in chemistry may not be influenced more by the lecture technique, which is a teacher-centered approach.

Hornby defines ability as a degree of intellect (2010). The degree of a student's ability is a significant determinant of how well they do in school. The ability of pupils is determined at the conclusion of a teaching and learning technique used by a teacher. It was found that Jimoyiannis and Komis (2001) found that including simulation into the teaching and learning process might

assist students dispel misunderstandings and increase their proficiency with various chemical subjects. When it comes to teaching low-ability kids, this study will determine whether strategy is more effective: simulation or lecture.

Another element that might affect students' chemistry grades is their sexual orientation. The status of being a man or a woman, a boy or a girl, is referred to as sex (Ekeh, 2000). Many scholars have conducted numerous studies to determine whether or not gender has an impact on academic ability. However, studies on the impact of simulation methods on the academic accomplishment of male and female students have been published. While Eze (2001), Nwankwo and Madu (2014) claim that sex has no effect on students' academic performance and retention, Fabunmi (2004), Adigun, Onihunwa and Sada and Adesina (2015) have found evidence indicating sex has a major impact on students' academic performance and retention. An investigation of this dispute serves as one of its main purposes. A computer simulation model will be used to see whether male and female pupils vary in their academic performance and ability to retain information.

Research in Delta State will focus on how computer simulations may help pupils better comprehend the particle nature of matter in secondary school. For the purposes of this research, students' academic performance, ability, gender, and persistence in Chemistry will be especially examined.

Statement of the Problem

Despite the critical role that chemistry plays in the growth of the country, students' performance in the subject is troubling. With a mean score of 40.0 and a standard deviation of 14.46 compared to a mean score of 29.0 and a standard deviation of 13.76 for WASSCE for school candidates in 2018, the WAEC Chief Examiner's Report of May/June (2019) found that candidates' performance was superior to that in 2018. The Chief Examiner said that this performance was due to a lack of knowledge and grasp of Chemistry topics. Stakeholders in scientific education are alarmed by the reduction in student performance in chemistry. Teaching techniques have been blamed for this low performance, but it's not the only one. Onwe and Uwaleke 2019 found that in Nigeria, the lecture technique is the most often used mode of teaching, with students passively participating in the teaching and learning process. The lecture approach is often used by professors to impart knowledge, which may explain why students struggle to grasp fundamental ideas in chemistry. A lack of active participation by students in the lecture approach might be a contributing factor to their low performance on the chemistry exam. Teachers of chemistry should use computer simulation models that allow students to engage and talk with each other as if they were in a real-life setting. Students' motivation and absorption of important topics during teaching may be aided by the presentation of the computer simulation in audio visual form. Student involvement in classroom simulations is enhanced when students are completely immersed, which in turn increases students' ability to retain and apply learned information.

Therefore, the problem of this study is: will the use of computer simulation instructional model improve students' achievement and retention in particulate nature of matter more than lecture method?

Purpose of the Study

The general purpose of this study was to investigate the effects of computer simulation model on secondary school scholars understanding of the particulate nature of matter. Specifically, the study sought to:

i. find out if there is a difference between the achievement scores of students taught Chemistry with computer simulation model and lecture method:
ii. Compare the difference in the achievement of male and female students taught Chemistry with computer simulation model;
iii. find out if there is a difference in the mean retention score between male and female students taught Chemistry using computer simulation model and lecture method;
iv. compare the difference in the achievement test scores between high and low ability students taught Chemistry using simulation method;

Research Questions

The following research questions guided the study.

i. What is the mean achievement scores of students taught Chemistry using computer simulation model and lecture method?
ii. What is the mean achievement scores of male and female students taught Chemistry using computer simulation model?
iii. What is the mean retention scores between male and female students taught Chemistry using computer simulation model and lecture method?
iv. What is the mean achievement test scores between low ability students taught Chemistry using simulation method and lecture method?

Hypotheses

The following hypotheses were formulated and tested at .05 level of significance:

i. There is no significant difference in the achievement scores of students taught Chemistry using computer simulation model and lecture method.
ii. There is no significant difference in the achievement of male and female students taught Chemistry using computer simulation model
iii. There is no significant difference in the mean retention scores of students taught Chemistry using computer simulation model and lecture method.
iv. There is no significant difference in the achievement test scores between low ability students taught Chemistry using simulation method and lecture method.

RESEARCH METHOD AND PROCEDURE

A quasi-experimental research approach was used in this study. The population for the study comprised all Senior Secondary Two (SSII) Chemistry students of the four hundred and seventy – one (471) public secondary schools in Delta State. The total population of SSII students under study is forty two thousand, eight hundred and eight (42,808) (Ministry of Basic and Secondary Education Asaba, 2020). Six public high schools in Delta State participated in the research, as did six chemistry instructors, six students from Senior Secondary Class 11 (SS 11), or one class per school, and two hundred and thirty-six (236) students from Senior Secondary Class (SSII) of Chemistry. Each of the three senatorial districts had two schools chosen for this research. Simple Random Sampling Technique was used to choose two schools from each senatorial district. Using a simple random selection method, one complete class was picked from each of the examined schools (balloting with replacement). In this investigation, two devices were employed to gather data. Accomplishment Tests for Chemistry (CAT) and a Scholastic Ability Test for Chemistry (SATIC). There were thirty (30) multiple-choice questions on the Delta State Government promotion examination's scholastic Ability Test in Chemistry (SATIC). SATIC was used to identify children with high and low levels of ability. 50 multiple choice questions derived from a six-week teaching unit in Chemistry covering matter, physical and chemical change, phase change of state, elements, compounds, and mixes, atomic structure, and isotopes were included in the Chemistry Achievement Test. To aid with distribution of Chemistry Achievement Test items, the researcher created Table 3, which displays this information. The specification table guarantees that all of the unit's content areas are represented. Blueprint depicts the cognitive exam of knowledge, understanding and application represented by the test items in instrument. Curriculum subjects from a high school senior English class were used to develop this lesson plan, which was written by the researcher. The Chemistry Achievement Test's grading methodology was devised by the researcher. Both the pre-test and post-test were administered using the Chemistry Achievement Test. Before and after therapy, the same instrument was used to deliver the Chemistry Achievement Test, which was then reshuffled and retested. The retention exam was performed two weeks after the post-test. The posttest was identical to the pretest in terms of retention. According to the Kuder-Richardson formula 21, the Chemistry Achievement Test (CAT) is reliable (KR21). Using this strategy for multiple-choice objective tests is an argument for its usage. Using a test-retest method, the instrument was administered to fifty (50) chemistry SSII students in Urhuoke Secondary School, Urhuoka Abraka in Ethiope East Local Government Area of Delta State who were not included in the study's scope. The data was then subjected to the Kuder – Richardson formula. An evaluation of the data yielded a reliability coefficient of 0.77.

Cooperative learning had a positive influence on the accomplishment of integrated science students in a research conducted by Ajaja and Eravwoke (2010). The simulation approach was taught to three instructors out of six in the chosen schools. All in all, it took six days. As soon as possible after arriving, the researcher went to the school heads (principals) and asked for

permission to utilize their staff and pupils for the research. On the second day, the researcher with the support of two specialist instructors introduced the three teachers to the characteristics, origin, and principles of simulation teaching approach. Training manuals on simulation instructional methods of teaching prepared by the researcher were used to educate instructors throughout day three. As a research assistant, you were given the opportunity to practice and produce suggestions for using simulation instructional technique in teaching SS I1 chemistry's particulate nature of matter concept during the fourth and fifth days. Researchers and two other expert instructors constructively evaluated trained Chemistry teachers on the final day of training, and when they were completely convinced that the trained teachers can accurately use simulation instructional method in teaching the particulate nature of matter, the training was over. The three lecturing instructors (the control group) had no formal training since they are used to lecturing as a technique of instruction. A lesson plan for the instructional units was provided to the three lecture technique instructors by the researcher in order to eliminate discrepancies in that group's treatment.

Assignment of pupils to experimental and lecture groups was the initial phase of therapy (control). The experimental group consisted of three intact SSI1 classrooms from the six schools chosen for the research (Three schools for simulation method group). Groups of students were assigned to three remaining SSI1 courses from each institution (control group). Experimenters and control subjects were exposed to identical chemical topics. The simulation instructional approach was used to train the experimental groups, whereas the lecture instructional method was used to train the control groups. The six educators from the six schools that were chosen to participate in the study worked as research assistants. They received education in both the simulation and lecture methods of teaching.

Step by Step Treatment Procedure

The treatment groups consist of:

a. Experimental group (Simulation Instructional Method) and
b. Control group (lecture method group)

Six weeks of therapy were required. Within a week following the start of treatment, the researcher distributed the instructional units between the experimental and control groups, as well as to the six research assistants involved in the study. Students will learn about the elements, compounds, and mixes, as well as the atomic structure and isoptoes from Ababio's New School Chemistry in these chemistry-focused lessons (2005). As a means of familiarizing the instructor with the subject matter and ensuring that all educational presentations adhere to the required structure for the courses, the instructional units were sent.

The 50-item Chemistry Achievement Test was administered to both the experimental and control groups two days prior to the start of therapy (CAT). This was done in order to ensure that any changes seen after treatment were the result of the therapy and not the result of the groups' prior

equality. Students in the control group were given a lecture-style presentation of all six weeks' worth of training material. The final versions of the subject materials were distributed equally among the three professors who instructed the students in the control groups. Simulated classrooms were used in the experimental classes.

Mean and standard deviation were used to answer the research questions in this study. As there was no significant difference in pre-test scores between the two groups when testing hypothesis I, II, III, and IV, a t-test statistic was employed to test these hypotheses while ANOVA was used to test hypotheses V, VI, VII, VIII, ix, and XI. Hypothesis testing was found to be significant at a level of.05.

Results and Discussion of Findings

The results of the pretest for both groups were analysed using t-test to determine whether both groups were equivalent before instruction. The result is presented below,

Table 1: Mean and standard deviation of pre-test achievement test scores of the groups.

Method	N	$\bar{X}$	Mean Diff	SD	SD ERROR
Computer Simulation Model (CSM)	102	12.75	0.09	2.16	0.209
Lecture	134	12.84		2.94	0.254

From the table above, lecture method had a higher mean than the computer simulation model (CSM). To determine whether the difference is significant, t-test was employed and the result is presented in table 1

Table 2: t-test comparison for the equivalent of the groups

Method	N	$\bar{X}$	SD	df	P val	Decision
CSM	102	12.75	2.16			
Lecture method	134	12.84	2.94	234	0.774	Not Significant
		P > .05				

From the P-value in table 2, it shows that there is no significant difference between the two groups before treatment. Therefore, the equivalent of the groups was established.

Research Question 1

What is the mean achievement scores of students taught Chemistry with computer simulation model and lecture method?

Table 3: Mean and Standard deviation showing pre-test and post-test achievement scores of students taught Chemistry using computer simulation model and lecture method.

Teaching Methods	N	Pre-test	$\bar{X}$	Mean Diff	SD	Post-test	$\bar{X}$	Mean Diff	SD
CSM	102		12.75		2.16		32.16		4.92
Lecture method	134		12.84	-0.09	2.94		22.16	10	5.26

Pre-test scores of 12.75 and 12.84 were recorded for students who were taught Chemistry using a computer simulation model and a lecture technique, respectively. The average difference is -0.09. However, in the post-test, the experimental group (computer simulation) had a higher mean score of 32.16, with a standard deviation of 4.92. There was a standard variation of 5.26 points in the control group (lecture), which had a mean accomplishment score of 22.16. The standard deviation is 10. Therefore, students who taught Chemistry using a computer simulation model gained more than students who taught Chemistry using the lecture technique.

Hypothesis 1

Ho1: There is no significant difference in the achievement scores of students taught Chemistry using computer simulation model and lecture method.

Table 4: t-test comparison of mean achievement post-test scores of students taught Chemistry using computer simulation model and lecture method.

Teaching Methods	N	$\bar{X}$	SD	Df	P val.	Decision
C S M	102	31.16	4.92			
Lecture method	134	22.16	5.26	234	0.000	Significant

P < .05

Table 4 shows that at .05 level of significance and 234 df, the P-value of 0.000 is lesser than .05. Thus, the null hypothesis is rejected. Therefore there is a significant difference in the achievement scores of students taught chemistry using computer simulation model (CSM) than lecture method.

Research Question 2

What is the mean achievement scores of male and female students taught Chemistry using computer simulation model?

Table 5: Mean and Standard Deviation statistics showing the achievement test scores of male and female students taught Chemistry using computer simulation model

Sex	N	$\bar{X}$	Mean Diff	SD
Male	55	31.93		4.86
Female	47	32.43	0.50	5.12

Table 5 shows a post-test mean achievement score of 31.93, with a standard deviation of 4.86, for male students taught with computer simulation model, while their female counterpart had a

post-test mean performance score of 32.43, with a standard deviation of 5.12. The mean difference between both sexes is 0.50, in favour of female students taught Chemistry using computer simulation model.

Hypothesis 2

Ho2: There is no significant difference in the achievement of male and female students taught Chemistry using computer simulation model.

Table 6: t-test comparison on the achievement test scores of male and female students taught Chemistry using computer simulation model.

Sex	N	$\bar{X}$	SD	df	P val.	Decision
Male	55	31.93	4.86			
Female	47	32.43	5.12	100	0.623	Not Significant

P > .05

Table 6 shows that at .05 level of significance and 100 df, the P-value of 0.623 is greater than .05. Thus, the null hypothesis is not rejected. This implies that there is no statistically difference in the performance of male and female students taught Chemistry with computer simulation model.

Research Question 3

What is the mean retention scores of students taught Chemistry using computer simulation model and lecture method?

Table 7: Mean and standard deviation statistics showing the mean retention scores of students taught Chemistry using computer simulation model and lecture method

Methods	N	$\bar{X}$	Mean Diff.	SD
C S M	102	29.27		5.01
			11.15	
Lecture method	134	18.12		5.14

Table 7 shows a retention mean score of 29.27, with a standard deviation of 5.01, for students taught Chemistry with computer simulation model, while students taught Chemistry with lecture method had a retention mean of 18.12, with a standard deviation of 5.14. The mean difference between both methods is 11.15, in favour of students taught with computer simulation model.

Hypothesis 3

Ho3: There is no significant difference in the mean retention scores of students taught Chemistry using computer simulation model and lecture method.

Table 8: t-test comparison of post-test mean retention test scores of students taught Chemistry using computer simulation model and lecture method

Method	N	$\bar{X}$	SD	Df	Pval.	Decision
C S M	102	29.27	5.01			
Lecture method	134	18.12	5.14	234	0.000	Ho_3 is rejected

P < .05

Table 8 shows that there is no significant difference in the retention scores of students taught Chemistry with computer simulation model and those with lecture method, at .05 level of significance and 234df; the P-val of 0.000 is lesser than .05 which is significant. Therefore, Ho3 is rejected. This implies that there is a significant difference in the mean retention scores of students taught Chemistry using computer simulation model and those taught with lecture method.

Research Question 4

What is the mean achievement test scores of low ability students taught Chemistry using computer simulation model and lecture method?

Table 9: Mean and standard deviation showing the achievement test scores of low ability students taught Chemistry using computer simulation model and lecture method

Methods	N	Mean	Mean Diff.	SD
CSM	64	31.2		4.41
Lecture method	117	21.70	10.11	4.81

Table 9 shows the mean achievement scores of low ability students in CSM was 31.23 with a standard deviation of 4.41 while low ability students in lecture method had a mean of 21.70 and standard deviation of 4.81 with a mean difference of 9.53. From the result there is a difference in the mean achievement test scores between the low ability students taught Chemistry using simulation method and lecture method.

Hypothesis 4

Ho4: There is no significant difference in the achievement test scores of low ability students taught Chemistry using computer simulation model and lecture method.

Table 10: t-test comparison of the mean achievement test scores of low ability students' taught Chemistry using computer simulation model and lecture method.

Method	N	$\bar{X}$	SD	Df	Pval.	Decision
C S M	64	31.23	4.41			
Lecture method	117	21.70	4.81	179	0.000	Significant

P < .05

Table 10 shows that .05 level of significance and 179 df, the P-value of 0.000 is lesser than .05. Thus the null hypothesis is rejected. This implies that there is a statistically significant difference in the achievement scores of low ability students taught Chemistry using simulation method and lecture method

Discussion of the Findings

Effects of Computer Simulation Model and Lecture Method on Achievement

Students who were taught chemistry using a computer simulation model as opposed to a lecture technique had significantly different mean accomplishment scores, according to the study's initial result. Students' varying levels of proficiency in Chemistry may have been impacted by the varying teaching approaches used in each of the groups, as seen by the disparities in their test results. Students who were taught chemistry using a computer simulation model did better than those who were taught using a lecture technique, according to a t-test study. As a consequence of their active engagement and interaction in the learning process, pupils may have achieved this result. Students in the computer simulation group may have benefited from this. A computer simulation method allowed students to observe, participate, and exchange ideas with their classmates. When pupils are actively engaged in the learning process, they learn more effectively. However, the lecturer gave the pupils with the necessary information. The lecturers' explanations were received by the pupils as though they were passive listeners. Students in the lecture technique group may have performed less well because of their lack of active participation.

Cigrik and Ergul (2009), who studied the influence of simulation-based instruction on students' accomplishment and attitude in electrostatic induction, found that students in the computer simulation model group performed better than those in the lecture method group. A study by Cigrik and Ergu (2009) found that simulation-based instruction improved students' performance in physics more than lecture-based instruction. With this conclusion, Umoke and Nwafor (2014)

may support their research into how instructional simulation affects secondary school students' biology success. According to their findings, students who were taught using a simulation-based instructional technique outperformed those who were taught using a lecture method. Olalekan and Oladipe (2016), who conducted a study on the effects of computer simulation instructional strategy on Biology students' achievement in DNA replication and Transcription, found that computer simulation instructional strategy enhances students' achievement in chemistry more than the lecture method.

Computer Simulation Model and Sex on Achievement

Students of both sexes who were taught chemistry using a computer simulation model had similar mean performance ratings, according to the study's second conclusion. This was owing to the fact that students of both sexes were drawn to and kept interested in the computer simulation model. A similar study by Olalekan and Oludipe (2016) found that students' academic success in DNA replication and transcription improved when they were taught using computer simulations. They found that students exposed to computer simulation teaching strategies performed as well in biology regardless of their gender. An earlier research by Umoke and Nwafor (2014) found that students' performance in Biology improved as a result of instructional simulation. They found that the mean achievement scores of male and female students who were taught Biology utilizing the simulated teaching style were not statistically significantly different. Lasisi, Oti, Arowolo, Agbeyenku, and Ojoko (2021) also found that creative computer simulation education improved students' performance in abstract scientific ideas. As a result of their research on computer simulation-based training, the researchers found that gender had no effect on the performance of students in science who were exposed to the method.

Effects of Computer Simulation Model and Lecture Method on Retention

Using computer simulation models and lectures, researchers discovered a substantial difference in the mean accomplishment scores of chemistry students. In comparison to the lecture technique, a computer simulation model had much higher mean retention ratings. This means that students taught chemistry using computer simulation models recalled more of the information they were given than students taught using the lecture technique. Students' active engagement in class is a good indicator of the effectiveness of a computer simulation model. To guarantee that students actively engage in the teaching and learning process, computer simulation models are used. This was not the case, however, with the lecture technique, in which students are encouraged to actively participate in class. Students' academic progress in DNA replication and transcription was shown to be positively impacted by a computer simulation teaching technique, according to Olalekan and Oludipe (2016). According to the results, pupils who were taught chemistry using a computer simulation model fared better than those who were taught using a lecture technique. Findings that are consistent with those of the researchers who studied the impact of an interactive computer simulation package on students' accomplishment and retention in genetics topics are also supported by Asogwa, Muhammed, Asogwa and

Ofoegbu (2016). They found that students who were taught chemistry using an interactive computer simulation had higher achievement and retention scores than those who were taught using a lecture technique.

Effects of Computer Simulation Model on Ability

The study's fourth conclusion was that low-ability students who were taught Chemistry using a computer simulation model performed much better than those who were taught using a lecture technique. This research demonstrated that the low ability students of computer simulation model did much better than the low ability students of lecture technique. The research further indicated that there was an improvement in the low ability children in their posttest mean achievement scores. This might be due to the computer simulation method which engages students' attention and makes them active participants in the learning process. This conclusion is in accordance with that of Eyitara and Baykara (2017) who evaluated the influence of simulation on the capacity of first year nursing students to understand vital signs. They demonstrated that students subjected to simulation to evaluate vital signs in healthy persons and patients gain in ability. This research is also backed by the perspective of Ellah (2016) who discovered that students' with high mental capacity had a more favorable attitude towards science than those with low and moderate ability accordingly.

Conclusions

The following is the study's conclusion: Using a computer simulation model rather than a lecture technique increases student success and retention in chemistry. The use of a computer simulation model has been shown to improve the chemistry grades of both male and female students. Students' performance in Chemistry was not influenced by the use of a computer simulation model and lecture approach. Students in both high and low grades who were taught using computer simulation models instead of lectures showed larger gains in skills, according to the findings of the research. When it comes to Chemistry, computer simulation outperforms the lecture technique in terms of improving student performance and retention.

Recommendations

Based on the findings of this study, the study recommended that:

1. Teachers of chemistry at the secondary level should employ computer simulation to increase student involvement and engagement throughout the teaching and learning process.
2. In order to utilize computer simulation strategies in the classroom, school managers need educate and retrain chemistry instructors in software design.

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