Effect of Computer Simulations and Instructional Games on the Academic Achievement of Senior Secondary School Students in Mathematics at Sokoto State in North Western Nigeria

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Abstract

This study investigated the effect of simulations and instructional games on the academic achievement of senior secondary school students in mathematics at Sokoto state in northwestern Nigeria. The study used pretest-posttest control group quasi-experimental design on 200 senior secondary school students from Secondary School in the state. The population comprised all senior secondary school students offering mathematics as a compulsory subject in Sokoto state. Purposive sampling techniques and simple random sampling were used to select the sample. The instrument used for data collection in this study was the Simulations and Instructional Games Mathematics Academic Achievement Test Scale (SIGMAATS). Data collected were analyzed using descriptive and paired sample t-tests. Findings from the study revealed that instructional games positively affect students' academic performance in mathematics, the finding also showed that computer simulation has a statistically significant effect on students' academic performance in mathematics The study concluded that the use of stimulating teaching methods goes a long way in sustaining and motivating the interest of students in learning mathematics. Based on the findings, it was recommended that Mathematics teachers should always direct students towards positive attainable goals to reduce low interest, rate of failures and difficulties in mathematics and making teaching and learning of mathematics in secondary schools vivid, practical, meaningful and applicable to our-day- to day activities through the application of computer instructional games and computer simulations.

Keywords: *Academic achievement, Simulations and Instructional Games*

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Background to the Study

Data provided by the West African Examinations Council (WAEC) and verified and validated by the National Bureau of Statistics (NBS) for the year 2021 revealed that out of the total number (male = 1,284, female = 1,090, total = 2,374) of secondary school students who sat for WASSCE in private schools in Sokoto state for the year 2021, (male = 1,259, female = 1,062, total = 2,321) students had 5 credits and above including Mathematics in private schools in Sokoto state. Out of the total number (male = 1,538, female = 618, total = 2,154) of secondary school students who sat for WASSCE in public schools in Sokoto state for the year 2021, (male = 1,087, female = 592, total = 1,679) students had 5 credits and above including Mathematics in private schools in Sokoto state (National Bureau of Statistics, 2022).

Mathematics is a subject that is very easy to make difficult and very difficult to make easy. He then suggested that the style or approach of a teacher employed in teaching cultivates more in motivating learners to teach (Adam et al., 2019). Akinsola (2002) also noted that the perennial methods of teaching mathematics through listening and learning have not been successful and also resulted in making students hate mathematics. Effective learning occurs when learning strategies are effectively organized and presented so that the learner can see the relationship between an element and another in the learning situation.

However, the use of simulation-game is suggested to teach and learn mathematics in secondary schools to provide a motivational environment, challenging and making learning experimental and demand active participation by students to the expectation of all the stakeholders such as parents, the general public, teachers, students and government. Games are one of the oldest forms of human social interaction which serve as an integral part of all cultures. They are formalized expressions of play that allow people to go beyond immediate imagination and direct physical contact. Games were relevant as teaching tools, as cultural and social bonding events and as markers of social status. Some common features of games are uncertainty of outcomes, competition, agreed-upon rules, separate place and time, element of chance, prescribed goals and personal enjoyment (Adam et al., 2019).

Games have been employed in teaching and learning science and mathematics in several countries due to their usefulness in the education process. In the same vein, Aremu (1998) and stated that practice with games instruction produced better test performance than the traditional style of teaching because games improve learning. According to Okigbo (2011), games enhance the Mathematical thinking of learners; imbibe in them a culture of cooperation, competition, organization and individualism spirit.

Games are divided into two groups by Cruickshank (1980), which are non-academic games and academic games. He described non-academic games as the type that are primarily designed for fun while academic games are primarily based upon learning. The primary focus of an academic game is to make learning more interesting for students and

challenge them in these academic areas. Academic games can be employed in mathematics when teaching and learning topics such as equations, sets and so on. There are two types of academic games which are non-simulation- games and simulation-games. He thus described non-simulation- games as the type of game in which a student solves mathematics problems in a school subject by solely making use of that subject while simulation-games is the ones in which students are provided with a simulation environment in which are expected to play in. Simulation is a situation when activities are presented as if they are real. Simulation is derived from the Latin word 'similes' which means to act. It is a representation of a real problem, event, object or situation and makes the learner an active participant in behaviour modification and skills acquisition Orlich et al. (1988).

Simulation techniques arouse interest, enhance skill development, provide adequate information, make learning more practical, vivid and meaningful, help learners determine the pros and cons implication of a given task, change altitude and improve the performance of teachers and students in the classroom (Manguwat, 2004). It is the practice with the use of teacher-made objects before trying the real object and then involves learning experiences which do not require immediate exposure of the learners to the real object.

Buttressing the advantages of simulations, Reinhardt and Lofts Gardeen (1979) proved simulation to be useful not only because of its ability to provide acceptable numerical results but also perhaps more relevantly because successful simulation requires a full understanding of the problems to be solved. The usefulness of simulation games in teaching and learning cannot be undermined because using simulation and games to teach may make learning remain permanent. Likewise, Ramdel et al. (1992), claimed also that the positive answers obtained for retention over time favor the use of games and simulation. Games and simulation can greatly assist in learning mathematics especially when handling the difficult concepts that students found to be difficult to comprehend. They provide an environment whereby students can see and make applications and have the ability to hold the attention of almost all the students. Simulation games also enable the students to form mathematical data with supplied information and enable learners to know the contrast between relevant and irrelevant information. They can be designed for learners with various age pairs and learners with varied learning abilities. Thus, games and simulation have a great impact and contribute immensely to the improvement of teaching and learning mathematics in Nigeria secondary schools.

Conventionally, teachers utilize a teacher-to-student direct approach, but with technological advancements, such as the application of computers, the Internet, visual applications, social networks and video technology, teachers apply novel instructional approaches to instruction. The end product or output of instructions is to improve students' scholarly learning outcomes. Computer-Assisted Simulation Learning games (CASLGs) are tools and teaching approaches that facilitate teaching as well as learning through practice and illustration in a repeatable-driven atmosphere (Gruss, 2016).

CASLGs could be used in the learning of mathematics through the provision of real-life conditions for classroom learning and instructions. It is an instructional method that is student-centred (Adoke, 2015).

As rapidly evolving technological applications, games and simulations are already widely integrated into the traditional educational process. They are deployed extensively in the field of education, with an existing body of work examining the relationship between games and education (Yang, Chen, &Jeng, 2010; Chiang, Lin, Cheng, & Liu, 2011). In recent years, digital or web-based games have increasingly supported learning. In the context of online education, this research area attracts a significant amount of interest from the scientific and educational community, for example tutors, students and game designers. With the growing expansion of technology, instructors and those who create educational policy are interested in introducing innovative technological tools, such as video games, virtual worlds, and Massive Multi-Player Online Games (MMPOGs) (Buckless, 2014; Gómez, 2014). Games are already, to a certain degree, integrated into educational systems to achieve a variety of learning outcomes (Connolly, 2012),

Games are sometimes used in error to mean simulation. Some scholars merge the two words or concepts to have a simulation game. A game is a structured exercise that requires and rewards the use of specific abilities or skills. Each participant strives to outshine others in the demonstration of skills and abilities and, consequently, in the total points as the game progresses. There are winners and losers at the close of games (Al-Zaytoonah, 2016). Some games are developed to teach or exercise certain cognitive or social behaviour skills, knowledge and competencies, which are of educational importance (Adoke, 2015). For example, the Snake and Ladder, monopoly, etc., games have been developed to promote educational significance. As a game is played severally, the students master the concepts the game is meant to depict (Obro, Ogheneaokoke & Akpochafo, 2021).

Ogheneakoke, Obro, and Benike (2019), stated that simulation is one of the problem-solving learning and teaching activities/methods. Simulations replicate real societal issues and problems and their networks of related variables. These issues and all other factors that affect them are modelled in simulation class execution (Sulaiman, Ibi, & Bukar, 2016). The majority of simulation models are developed around a single problem, and individuals or groups are assigned aspects of the problem to explore or study. The classroom simulation is finally executed. The problems or issues at hand are presented as real, and the interplay of different factors is likewise presented in the execution of a classroom simulation. The students are then made to ruminate on the problems/issues in their entirety or wholeness and advance a workable solution to them (Vlachopoulos & Makri, 2017). The issue of appropriate instructional methods in the teaching and learning of mathematics is vital, as this constitutes what and how mathematics could be taught in our schools. Instructional strategies adopted by the teachers could influence the cognitive, affective and psychomotor outcomes of the learner. Many professional

teachers do not use appropriate teaching methods and teaching aids in the classroom that can stimulate students. Some use sterile and uninspiring methods (Obodo, 2004). This pattern is a conservative approach where the teacher, in most cases, is seen and acts as the repertoire of knowledge and the students the dormant recipient (Aladejana, 2007). Therefore, this study investigated the effect of simulations and instructional games on the academic achievement of senior secondary school students in mathematics at Sokoto State in North Western Nigeria.

Objectives of the study
1. To investigate how instructional games can enhance students' performance in mathematics in Secondary Schools.
2. To establish how simulations can enhance students' performance in mathematics in Secondary Schools.

Research Hypotheses
This study will seek to test the following research null hypotheses**:**

H_{01} Computer instructional games have no statistically significant effect on students' academic performance in mathematics.

H_{02} Computer simulations have no statistically significant effect on students' academic performance in mathematics.

Literature Review
In recent years, the interest in examining game use in higher education has increased. This includes educational games (Çankaya & Karamete, 2009), digital game-based learning (DGBL) (Yang, 2012), and applied games (van Roessel& van Mastrigt-Ide, 2011). In addition, scholars, sometimes, include interactive exercises, video games (Biddiss & Irwin, 2010), or even expand to next-generation video games (Bausch, 2008), in the category of games. Concerning to web-based games, the technological platforms that implement digital game code include computers and consoles (Salen& Zimmerman, 2004). They can run on a web browser on mobile phones and other mobile gaming devices (Willoughby, 2008) (e.g., tablets).

Despite the abundance of game types, there is a lack of clear, shared definitions and terminology among scholars and educators, which has led to "terminological ambiguity" (Klabbers, 2009). Nevertheless, the need for shared terminology remains when discussing the different forms of games and simulations in higher education. Although academics and game developers may use varying taxonomy to categorise games, the majority broadly agree on the following seven genres (Gros, 2007): Action games: Adventure games: Fighting games: Role-playing games: Simulations: Sports games: and Strategy games. In recent years, several well-designed empirical studies investigating the effects of serious games on learning outcomes have been published. Sawyer refers to serious games as those games produced by the video game industry that have a substantial connection to the acquisition of knowledge (Sawyer, 2002).

Zyda (2005), expands Sawyer's definition, adding that serious games are games whose primary purpose is not entertainment, enjoyment or fun. Serious games, educational gaming, as well as virtual worlds developed for educational purposes reveal the potential of these technologies to engage and motivate beyond leisure activities (Anderson et al., 2009). At the same time, there is extensive literature exploring the potential learning benefits offered by game-based learning (GBL), which can be defined as the use of game-based technology to deliver, support, and enhance teaching, learning, assessment, and evaluation (Connolly, 2007).

Simulations create a scenario-based environment, where students interact to apply previous knowledge and practical skills to real-world problems, also allowing teachers to reach their own goals, as well (Angelini, 2016). During scenario-based training, the player acquires important skills, such as interpersonal communication, teamwork, leadership, decision-making, task prioritising and stress management (Flanagan, 2004). The practical scenario may be carried out individually or within a team (Robertson et al., 2009), leading to collaboration and knowledge sharing.

With the explosion of Web 2.0 technology, increased opportunities to engage with technological applications in a collaborative and participatory way have emerged, promoting information access, shared ideas, knowledge exchange, and content production (McLoughlin & Lee, 2008). Digital simulations, which engage students in the interactive, authentic, and self-driven acquisition of knowledge, are being adopted in higher education. Connolly and Stansfield (2006) define game-based e-learning as a digital approach which delivers, supports and enhances teaching, learning, assessment, and evaluation. Game-based e-learning is differentiated from GBL, which tends to cover both computer and non-computer games.

Delivery platforms are an essential aspect for game designers when creating and distributing games and simulations (e.g. computer, video, online, mobile, 3D, etc.). Designers must pay attention to characteristics such as the technical challenges, modules and techniques associated with the game design, the players involved in gaming, and the teaching modes (e.g. single, multi-player, collaborative, synchronous, etc.). This study examines the diverse curricular areas and learning objectives each game intends to access. The main difference between games and simulations is the following: games are tools which are artificial and pedagogical; they include conflict, rules, and predetermined goals, whereas simulations are dynamic tools, representing reality, claiming fidelity, accuracy, and validity (Sauve, 2007).

Umoke and Nwafor (2014), submitted that simulation is conceived as a representation of the behaviour or characteristics of a system through the use of another outlet, especially a computer programme designed for the purpose. According to Umoke and Nwafor (2014), it can mean mimicry, making working replicas or representations of machines for demonstration or analysis of problems but clearly illustrates real life or hypothetical situations. Simulation, according to Mitchell, Parsons, and Leonard, (2007), permits the

learner to manipulate variables or parameters and then to observe the consequences of their choices. It is a model of what exists or might exist in set or complex physical or social interactions or a representation of a manageable real event in which the learner is an active participant engaged in learning a behaviour by applying previously acquired skills or knowledge.

Pajarillo-Aquino (2019), examined the effect of online simulation games on students' scholarly learning outcomes. The researchers used a descriptive-co relational research design. This study design described the respondents' profiles and ascertained the difference between online computer-assisted simulation games in non-players' and players' scholarly learning outcomes. The study concluded that students playing online simulation games did not differ in their scholarly learning outcomes because the students still did well in their classes, as shown by what they learned. In a study by Serrano (2019) on CASLGs on student skill development, it was reported that the games were marginally beneficial for teaching mathematics to PreK–12 kids. Tokac, Novak, and Thompson (2019) looked at the effect of learning video simulation learning games on PreK–12th-grade students' scholarly learning outcomes in mathematics. Results from the study demonstrated that video simulation learning games showed slightly greater usefulness for teaching mathematics students across PreK–12th grades.

Gambari, Shittu, Falode, and Adegunna (2016), investigated the computer self-interactive package (CSIP)'s effectiveness on students' scholarly learning outcomes among second-year students instructed with CSIP. It was a quasi-experimental study involving 92 students. Results indicated improved students' scholarly learning outcomes in CSIP groups in comparison to non-CISP groups. Julius, Twoli, and Maundu (2018) examined the effects of CASLGs on the scholarly learning outcomes of chemistry students compared to traditional ways of teaching. This involves 174 chemistry students from four high schools chosen on purpose. The study established that CASLGs enhanced or boosted students' scholarly learning outcomes in comparison to the traditional ways of teaching. The CASLG group improved their scores compared to the students of the traditional ways of teaching. Ode (2018) explored the effect of computer-assisted simulation teaching games on the scholarly learning outcomes of students in government as a subject. The data collection instrument was a 25-item teacher-made test. The study sampled 100 senior secondary students, which were divided into two groups – the treatment/experimental group and the control group. Each group was instructed for eight weeks using computer-assisted simulation instruction programmed packages for the treatment/experimental group and a conventional instruction method for the control group. The study indicated that students instructed using computer-assisted simulation instruction significantly improved their scholarly learning outcomes compared to students instructed using conventional instruction methods.

Saprudin, Liliasari, Prihatmanto, and Setiawan (2019), compared the effects of digital simulation learning games on students' scholarly progress in small vs big courses with 58 preservice physics instructors divided into two courses, a small class and a big class. Both

classes explore the physics of light with the same digital simulation learning gaming program. A paper-and-pencil examination comprised of multiple-choice questions was used to gather data. The findings indicated that the adoption of a digital simulation learning game enhanced students' scholarly learning outcomes. There was a favourable correlation between the growth in academic accomplishment and the improvement in gaming scores.

Yesilbag, Korkmaz, and Çakir (2020), examined instructional computer simulation learning games' impact on the scholarly learning outcomes of students in the tenth grade. A total of 60 tenth graders participated in the study. A learning outcome test was administered as a pre- and post-test on the students. The study discovered that the experimental group did better than the control group. The findings imply that computer simulation learning games may be employed in education as an information communication technology (ICT) tool to improve students' English learning outcomes. Islam, Biswas, and Khanam (2020) investigated electronic gaming with scholarly learning outcomes in Australian children. A total of 1704 11–17-year-old children were the study sample. A national cross-sectional study employing generalized linear regression models with survey weighting adjustments was used to analyse collected data. The study demonstrated that electronic simulation gamers got higher reading scores over the week than those who did not play electronic simulation games.

Ukwetang, Nja, Eneyo, Ambe, and Etta (2021) researched to ascertain the effect of ICT simulated learning games on students' scholarly learning outcomes in tourism in Calabar Municipality. The study was a survey study that involves 200 sampled students. A performance test and a four-point rating scale questionnaire served as the data-gathering instruments. The hypotheses generated were tested using an independent student test. The result established that a significant difference did exist between the scholarly learning outcomes of students instructed with and without ICT-simulated learning games. Effiong, Ekpo-Eloma, Ekpo, Jacob, and Udoh (2022) assessed the effectiveness of smart slate simulation learning games on the scholarly learning outcomes of second-year students in Educational Technology. The study was quasi-experimental that utilised a pre-and post-test control group design. Using a purposive sampling method, 131 students were selected for the study: 66 in the experimental group and 65 in the control group. The Educational Technology Performance Test (ETPT) served as the data-gathering tool. Data were examined using analysis of covariance (ANCOVA). The study established that students instructed with the smart slate simulation learning game improved their scholarly learning outcomes. It was, thus, suggested that smart slate simulation learning games should always be utilized to improve students' scholarly earning outcomes and that instructors should construct their lesson plans using smart slate simulation learning games to encourage group work and enjoyment while learning.

Methodology
The study adopted quasi-experimental design of one group pre-test/post-test to establish the effect of simulations and instructional games on the academic achievement

of senior secondary school students in mathematics at Sokoto state in northwestern Nigeria. The study used a purposive sampling technique to select secondary school students who were offering mathematics as a compulsory subject. The study used a simple random sampling to select 200 participants from these students. The total sample size of the study was 200 senior secondary school students who were offering mathematics as compulsory subject in Sokoto state. The instrument used for data collection in this study was the Simulations and Instructional Games Mathematics Academic Achievement Test Scale (SIGMAATS). The reliability and validity of the instrument were tested through content validity and face validity, the reliability of the instrument was calculated to be 0.85. The quantitative data were analyzed using descriptive and paired sample t-tests.

Results

H_{01} Computer instructional games have no statistically significant effect on students' academic performance in mathematics.

The hypothesis was tested based on the instructional games (mathematics problems solving skills). In testing the research hypothesis, a paired-sample t-test was conducted on the performance of the students in Secondary School, who were taught with a computer-based instruction method. This was based on each element of the dependent variable (mathematics problems solving skills). The test value was 50 marks indicating that the paired sample t-test was conducted against a hypothesized value of 50. Under this presentation, the respondents were requested to write the test in line with the major research hypothesis and the analysis focused on pairing the results of pretest and post-test.

To test the research hypothesis, data were collected and analyzed by using paired sample t-tests with average test values for mathematics problems solving skills. The result of the analysis was presented in Tables 1 and 2 of paired sample statistics and paired sample test respectively.

Table 1: Paired Samples Statistics the effect of computer instructional games on mathematics problems solving skills.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	48.05	200	9.774	1.545
	Post-test	58.00	200	14.919	2.359

Source: Author's computation

The Tables 1 presented paired sample statistics that provided information about mathematics problem-solving skills using computer instructional games, having established that there is a significant difference. A sample size (n) = 200, the mean and standard deviation scores on the pre-test were (M= 48.05, SD =9.77) and the mean and

standard deviation scores on the post-test were (M =58.00, SD =14.92). This means that the mean scores for the mathematics problem-solving skills of the students is (58.00±14.92) and (48.05±9.77) this shows that the majority of student had reached the required pass mark score in mathematics problem-solving skills in the post-test. However, the researcher was interested in knowing whether the mean score of the mathematics problem-solving skills of the students in both pre-test and post-test had reached the average mean of the required pass mark score in mathematics (which has a mean of 50).

Table 2*: Paired Samples Test the effect of computer instructional games on mathematics problems solving skills.

		Paired Differences					T	df	Sig.
		Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Post-test – Pre-test	9.95	11.97	1.89	6.12	13.78	5.258	199	.000

Source: Author's computation

Table 2 revealed a paired sample t-test that evaluates the effect of computer instructional games on mathematics problem-solving skills scores. It revealed that students score higher in the post-test using computer instructional games (M= 58.00, SD= 14.92) is greater than the mean score of pre-tests (M = 48.05, SD= 9.77). There was a statistically significant increase in the mathematics problem-solving skills from (M = 48.05, SD= 9.77) to [(M = 58.00, SD = 14.92), t (199) =5.258, p=< .05]. The mean increase in problem solving skills scores was 9.95 with a 95% confidence interval ranging from 6.12 to 13.78. based on these findings, it is therefore concluded that instructional games positively affect students' academic performance in mathematics.

This finding is in line with previous researchers like Adam et al. (2019), revealed that students' poor academic achievement in mathematics is partly due to the method of teaching used. Also, the findings revealed that the use of games and simulation environments led to improve achievement and positive attitudes towards mathematics. The study concluded that teachers' use of stimulating teaching methods would go a long way in sustaining and motivating students' interest in learning mathematics. The findings of this study are also in agreement with Obro (2022) who showed that CASLGs improved students' scholarly learning outcomes more than the face-to-face instructional approach. This implies that students exposed to CASLGs improved more than those instructed with the face-to-face teaching approach. This suggests that CASLGs are effective and increase students' scholarly learning outcomes. This result collaborates with that of Sulaiman, Ibi and Bukar (2016) and Obro and Enayemo (2022) who reported that CASLGs improved students' scholarly learning outcomes significantly. Furthermore, the

study results confirmed that Vlachopoulos and Makri (2017) and Kornak-Bozza (2017), who in their studies revealed improved learning outcomes for students, taught using CASLGs. This result might be because CASLGs is an activity and problem-solving-oriented teaching approach. Therefore, classroom activity founded on CASLGs results in decreased rote learning and increased learning. This is because it makes sure that students who take part in classroom activities at every stage and time of learning use their time and effort wisely.

H_{02} Computer simulations have no statistically significant effect on students' academic performance in mathematics.

This study tested the hypothesis based on the simulation (mathematics learning abilities). In testing the research hypothesis, a paired-sample t-test was conducted on the performance of the students who were taught with the computer-based instruction method. To test this hypothesis, The result of the analysis was presented in tables 3 and 4 of paired sample statistics and paired sample test respectively.

Table 3: Paired Samples Statistics the effect of computer simulations on mathematics learning abilities.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	48.05	200	9.774	1.545
	Post-test	52.50	200	12.486	1.974

Source: Author's Computation

The tables 3 above revealed a paired sample statistics table that provided information about mathematics learning abilities using computer simulations, having established that there is a significant difference. With a sample size (n) = 200, the mean and standard deviation scores on the pre-test were (M= 48.05, SD =9.77) and the mean and standard deviation scores on the post-test were (M =52.50, SD =12.49). This meant that means scores for the mathematics learning abilities of the students (52.50±12.49) and (48.05±9.77) revealed that the majority of students had reached the required pass mark score in mathematics learning abilities in the post-test.

However, the researcher was interested in knowing whether the mean score of the mathematics learning abilities of the students in both pre-test and post-test had reached the average mean of the required pass mark score in mathematics (which has a mean of 50).

Table 4: Paired Samples Test the effect of computer simulations on mathematics learning abilities.

		Paired Differences					t	df	Sig.
		Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Post-test – Pre-test	4.45	9.88	1.56	1.29	7.61	2.850	199	.007

Source: Author's computation

From Table 4 a paired sample t-test was computed to evaluate the effect of computer simulations on mathematics learning abilities scores. The table revealed that students score higher in the post-test using computer simulations (M= 52.50, SD= 12.49) is greater than the mean score of pre-tests (M = 48.05±9.77). There was a statistically significant increase in the mathematics learning abilities from (M= 48.05, SD= 9.77) to [(M = 52.50, SD = 12.49), t (199) =2.850, p=<.05]. The mean increase in problem-solving skills scores was 4.45 with a 95% confidence interval ranging from 1.29 to 7.61. based on this analysis, it is therefore concluded that computer simulation has a statistically significant effect on students' academic performance in mathematics.

This finding agrees with Awodun and Oyeniyi (2018), who found that there was a significant difference in the student's achievement in basic science before and after treatment in each of the groups. This result inplies that: the conventional method of instruction is not potent enough to effect positive change in students' achievement in basic science, whereas the simulation teaching approach expedites significant change in the achievement of students in basic science. This finding agrees with the research findings of Akinsola and Animasahun (2007), that simulation-game instructional strategy might be an antidote for students' poor academic achievement in basics science. The findings of this study also revealed that: there was no significant difference in the academic achievement of male and female students in basic science in each of the experimental and control groups before and after the treatment. In other words, the achievement of male and female students exposed to the simulation teaching approach did not differ significantly as female students were found to have similar achievement in basic science as their male counterparts in the two groups involved in the study. This result inplies that gender was not a significant predictor of students' achievement in basic science.

Conclusion
Going by the aim of this study was to investigate the effect of simulations and instructional games on the academic achievement of senior secondary school students in mathematics at Sokoto State in northwestern Nigeria. The study concludes that the simulation activities teaching approach is more potent in stimulating students' academic

performance in mathematics in secondary schools than the conventional method in vogue in the nation. It can also be concluded that the use of stimulating teaching methods would go a long way in sustaining and motivating the interest of students in learning mathematics. It can also be concluded that there is a positive relationship between the use of simulations and games and learning performance in mathematics through successful use of simulations and games: the specificity of the game, its integration into the course, and the role of a guiding instructor.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. All concerned stakeholders should pay more attention to the use of computer instructional games and computer simulations in mathematics in the Nigerian school system especially at the senior secondary level of education.
2. The teaching strategy (computer-assisted instruction) of computer instructional games and computer simulations in mathematics should be put to use. To make this possible, the stakeholders should mandate all classes in secondary schools to be taught mathematics by computer operation in their school curriculum.
3. Teachers and other facilitators should always be present to guide their students with computer instructional games and computer simulations in mathematics when teaching. This helps them to use the time allocated for their lesson or revision more effectively and efficiently.
4. Teachers should be trained in the use of both computer instructional games and computer simulations in mathematics so that they can teach their students well for better performance, especially in mathematics.
5. Students should have the opportunity to use both computer instructional games and computer simulations in mathematics to gain knowledge and skills in using them appropriately.
6. Mathematics teachers should always direct students towards positive attainable goals to reduce low interest, rate of failures and difficulties in mathematics and make teaching and learning of mathematics in secondary schools were vivid, practical, meaningful and applicable to our-day- to day activities through the application of computer instructional games and computer simulations.

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