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Simulation as a Tool for Assessing Physics Students' Academic Performance and Interest in Rivers State

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Abstract
The research study adopted the pre-test, post-test, quasi-experimental and descriptive survey design, because, the study described, Simulation, as an influencer in assessing Physics students' academic performance and interest in Rivers –State, on 3 experimental methods - Interactive, System Dynamics and Role- play simulation on Physics students' academic performance and interest and in Rivers-State. Three research questions and three hypotheses guided the study while the population of the study was made up of the entire senior secondary school two Physics consisting of 480 students in four out of ten co-educational public senior secondary schools in Rivers-state). The sample size consisted of 160 senior secondary two (SS2) Physics students and a control /intact SS2 Physics classroom, made up of the discussion groups selected using the purposive sampling technique based on functionality and equipped Physics laboratory. Two instruments were used in this research, the Simulation Physics Performance Test (SPPT) and the Simulation Physics Interest Questionnaire (SPIQ). The Kuder-Richardson (KR-21) formulae were used to ascertain the academic performance of Physics students at 0.86 reliability coefficient index while the Cronbach-Alpha formula was used for the interest of the students at a correlation coefficient of 0.82 while the Physics Interest questionnaires (PIQ) was analyzed using the SSPL to elicit the interest of Physics. The research questions were answered using the mean and standard deviation while the hypotheses were tested using the ANOVA to compare the difference between the mean interest scores of students taught Physics using the Interactive, System Dynamic, Role-play over the Discussion Group. The result of the experiment showed that the discussion method overruled other forms of simulation in their interest in Physics while the interactive simulation had a significant difference in the academic performance of Physics students. It was recommended among others that, adequate and standard technological facilities should be provided as a supportive resource material, to stir up the interest of Physics students through direct communication while the use of simulation should be used to stir up the academic performance of students to ensure efficiency.

Keywords: Simulation, Influencer, Role- Play, Interactive, System Dynamics, Academic Performance

Introduction

Physics is an integral part of mathematics; its perversity is applied in various topics, maximized through proofs, theorems, concepts and experiments in the teaching and learning of Physics that cuts across the millennial (Ntaka, 2023). Physics is a science subject that is essential in the production and application of technological devices, modernized equipment, tools and gadgets that are targeted towards advancement. Strikingly, over the years the academic performance and interest of students in Physics have continued to deplete, based on a long-established stagnation in traditional practices attributed to Physics instructions. This mirage is learning could be revisited by applying different forms of simulation in Role-play, System Dynamics and Interactive to neutralize inactions in external examinations that have persisted over the years in line with consistent failures. Influencers can change an atmosphere through their effect on characters in the entertainment world like social media (Ntaka, 2020) in TikTok, Instagram, Facebook, Google and others by cultivating a positive mindset among their viewers. In education, innovative techniques energize Physics students through actions in visuals and pictorial representations that set attract students and influence growth through the superimposition of innovative tools, ideas, method, strategies or approach in the teaching and learning of Physics. Simulation, is an influencer that magnetizes the activities of students through interaction, and visitation of social media educative sites and channels where homework and assignments are done with or without the supervision of teachers. Therefore, progressive teachers implement learning through experiences gathered over the years (Amadi, 2021), especially in the teaching and learning of Physics, towards spurring student's interest and annulling wrong perception in the study of Physics.

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Simulation is a way of arousing students' interest, by imitating the operation of real-world experiences and ensuring that physical objects are brought to the reality or surprise of students in a way that will fascinate them. (Fok, 2017), Udoh (2019) mentioned that the essence of this development is to break away from Physicsphobia on the fact that Physics is a difficult subject. Simulation re-direct students learning culture in modification and ground-breaking modules in superposition's method, to spur high academic excellence in external examinations. Korochentseva1 et al. (2020) described the role-play simulation as a possible strategy to nose dive young people in an active and controlled ways to express themselves and communicate, discover and develop skills that are productively conditioned functionally. It also provides students, with opportunities to learn and act in a simulated aligned environment in real-life situations, practised in the classroom. System Dynamics simulation is the study of structures, changes and experiences, witnessed within a period through the collection and development of topics, generated in diverse sites to enable students to communicate while Interactive Simulation creates new and innovative ways in the teaching-learning processes by providing new tools for illustrating, demonstrating and exploring basic concepts in Physics achieved through the use of computers, multimedia's, and the use of world-wide-web (www) visualized through the use of videos or pictorial representations that are available to serve in the discussion process. Nigeria has jinxed the league of developed countries in devising new strategies for facilitating educational instruction in Physics, though in the midst of these modifications, the discussion method, an interactive process that involves, numerous flows of communicative skills between the teacher and students that should not be completely overruled but enhanced to suit learners interest. (Ntaka, 2023). Lowman et al. (2017*)* clearly explained interest, as a relative stable and psychological characteristic of people that reveals personal evaluation (subjective and attributed to 'goodness' or 'badness'). Interest, remain a very vital point needed by a good teacher to steer up students towards effectiveness in the teaching and learning processes, to boost academic performance and to simulate vision and interest of students in Physics.

Academic performance represents outcomes and the extent to, which a person demonstrates spirited requirements in educational excellence. Strategically, simulation is utilized in multimedia structures to convey information by employing plans to learn Physics in an overwhelming way (Ntaka, 2023) to enhance academic performance. Therefore, academic performance in Physics is prerogative since it varies exponentially with the input of students. In this effect, Agbarakwe and Ntaka (2021) mentioned that some students could be poor in Mathematical Physics but could productively explore in experimental Physics classroom, only if the right simulation is employed to explore Physics students. Therefore, the researchers explored on the of simulation in three forms to visualize its impact on the academic performance and interest of students in Physics.

Statement of the Problem

Physics is the salt of science and a foundational science subject, without which there would be no scientists, medical doctors, physiotherapists, architects etc. The teaching and learning of Physics have been retarded by factors like inappropriate instructional methods, lack of interest, wrong senility, inadequate technological device and faulty foundation in passing on Physics instructions through the use of technological devices in practical-oriented ways. Inadequate teaching methods appear to be a chief because it has consistently affected students' sensitivity in Physics and this may have led to poor academic performance in the external examination, particularly in Ikwerre local government area of Rivers State. The researchers perceived that this anomaly may have contributed to poor academic performance recorded, taking into cognizance, the consistent abysmal in external examinations in Physics, as mirrored in the West African Examination Council (WAEC) which over the years, precisely (2016-2020) Physics students in Obio-Akpor Local Government area of Rivers-State. have consistently exhibited poor academic performance in Physics. The net academic performance recorded was also poor with an average score of 35.94% in a space of 5years, this failure within the said period is baffling while the researchers, questioned these inconsistencies and in a rescue mission suggested, the use of the simulation method to consider its appropriateness as an instructional tool to correct the variance in the teaching and learning of Physics. It is against this poor academic performance, of students in physics, that the researchers were inspired to scrutinize the use of simulation, as an influencer in assessing Physics students' academic performance and interest.

Objectives

Specifically, the objectives of the study were to:

1. Determine the interest of SS2 students taught Physics using the role-play simulation, over those using the discussion method.
2. Determine the academic performance of SS2 students taught Physics using the interactive, system dynamics, and role play simulation over those using the discussion method.
3. Determine the interest of SS2 students, who taught Physics using the interactive, system dynamics, and role play simulation over those taught using the discussion method.

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Research Questions

Three research questions were answered to meet the objectives of this study:

1) What is the interest of SS2 students taught Physics using the role-play simulation, over those using the discussion method?
2) How might we describe the academic performance of SS2 students taught Physics using the interactive, system dynamics, and role play simulation over those using the discussion method?
3) What is the interest of SS2 students taught Physics using the interactive, system dynamics, and role play simulation over those taught using the discussion method?

Hypotheses

H01: There is no significant difference in the interest of SS2 students who were taught Physics using the role-play simulation, over those using the discussion method.

H02: There is no significant difference in the academic performance of SS2 students who were taught Physics using the interactive, system dynamics, and role play simulation over those using the discussion method.

H03: There is no significant difference in the interest of SS2 students taught Physics using the interactive, system dynamics, and role play simulation over those taught using the discussion method.

Methodology

The research study adopted the pre-test, post-test, quasi-experimental and descriptive survey design, because, the study described, Simulation, as an influencer in assessing Physics students' academic performance and interest in Rivers –State.) that determined the effect on (three) experimental methods - Interactive, System Dynamics and Role- play simulation on Physics students' academic performance and interest and in Rivers-State while three Research question and three hypotheses guided the study. The population of the study was made up of the entire senior secondary school two (SS2) Physics consisting of, four hundred and eighty (480) students in four out of ten (10) co-educational public senior secondary schools in Rivers-state (Source: Rivers State Senior Secondary Schools Board, 2022). The sample size consisted of a hundred sixty (160) senior secondary two (SS2) Physics students comprising of (83 males and 77females) while three experimental schools (1, 2 and 3) and a control /intact SS2 Physics classroom, made up of the discussion groups, selected from each of the four senior secondary schools that made up Ikwerre local area of Rivers-state, using the purposive sampling technique based on functionality and equipped Physics laboratory, Information Communication Technology (ICT) compliancy and schools that had alternative power supply (sound generating set) in case of power surge.

Two instruments were used in this research, the first one was titled, Simulation Physics Performance Test (SPPT), developed and used for data collection after the instrument was given to the students which comprised (20) multiple choice objective questions drawn from all the five sub-topics in the topic, 'Machines' (Lever Screw, Wedge, Inclined lane and Wheel and Axle). The pre-test and post-tests consisted of the same items on the topics, while the second instrument was the Simulation Physics Interest Questionnaire (SPIQ) containing 14 item-structure questions, which were divided into two main sections. The questionnaire was developed and adopted for the study by two other experts while the Kuder-Richardson (KR-21)formulae ascertained the academic performance of Physics students at 0.86 reliability coefficient index while the Cronbach-Alpha was for the interest of the students at a correlational coefficient of 0.82, indicating a fairly high reliability index score, affirming that the instruments were consistent. The Physics Interest questionnaires (PIQ) experiences was analysed using the SSPL to elicit the interest of Physics students on implemented lessons that were targeted at enhancing students' understanding of the three implanted lesson plans. The data collected for the pre-test and post-test was collated and analyzed by presentation in tables, the research questions, were answered using the mean and standard deviation while the hypothesis was tested using the Anova on the difference in the academic performance of students taught using any of the three simulation experiment, tested using the F-test statistics at 5% level of significance, inferential statistics (Student's *t*est and ANOVA) used to analyse the data, while all the results were interpreted at ($p < 0.05$), before the administration of the proposed instrument while the Scheffe Multiple tests were used to compare the difference between the mean interest scores of students taught Physics using the Interactive, System Dynamic, Role-play over the discussion Group.

Results

Research Question 1: What is the interest of SS2 students taught Physics using the role-play simulation, over those using the discussion method?

Table 1: Posttest Mean Interest Score of the Role Play Simulation and Discussion Group

Method	N	Mean	S.D	SEM	Mean Diff.
Discussion	**40**	**62.95**	**12.11**	**1.91**	
Role-play Simulation	**40**	**51. 68**	**8.60**	**1.36**	**11.27**

Table 1: Indicated that students taught Physics using the discussion method, had a better interest than those using the role-play simulation method.

Research Question 2: How might we describe the academic performance of SS2 students taught Physics using the interactive, system dynamics, and role play simulation over those using the discussion method?

Table 2: Posttest Performance score of the Interactive, system dynamics, role play Simulation over the discussion method on academic performance score of SS2 Physics students, using Mean, standard deviation and Standard Error mean

Instructional Method	N	Mean	S.D	SEM
Interactive	40	76.97	12.37	1.96
System Dynamic	40	74.23	9.27	1.47
Role-play	40	65.28	16.21	2. 56
Discussion	40	65.50	14.74	2.33

The academic performance of the three types of simulation used over the discussion method, demonstrated that, the interactive simulation had the highest mean score in academic performance, followed by the system dynamic simulation, discussion method and role-play simulation in the range of (76.97, 74.23, 65.50 and 65.28)

Research Question 3: What is the interest of SS2 students taught Physics using the interactive, system dynamics, and role play simulation over those taught using the discussion method?

Table 3: Posttest of the Interactive, system dynamics, and role play simulation and discussion method on interest using mean, standard deviation and standard error mean

Instructional Method	N	Mean	S.D	Standard Error Mean
Interactive	40	59.32	12.27	1.94
System dynamic	40	58.76	12.99	2.05
Role-play	40	51.68	8.60	1.36
Discussion	40	62.95	12.11	1.91

Table 3, revealed that students treated with the discussion method had the highest mean interest score when compared to their counterparts, using the simulation methods: (Interactive system dynamics and the role-play simulation in the ranges of (62.95, 59.32, 58.76, 51.68)

H01: There is no significant difference in the interest of SS2 students who were taught Physics using the role-play simulation, over those using the discussion method.

Table 4: Summary of t-test Analysis of the Post-test Mean Scores of the Experimental and Control Group

Method	N	$\bar{x}$	S.D	df	t-Cal	t-crit	Mean	Standard Error Diff	Decision
Discussion	**40**	**62.95**	**12.11**				**11.28**	**2.35**	
				78	**4.8**	**1.99**			**Sig**
Role-Play	**40**	**51.68**	**8.60**				**11.28**	**2.35**	

Table 4 shows that a significant difference exists between the mean interest score of the role-play simulation and discussion group.

H02: There is no significant difference in the academic performance of SS2 students who were taught Physics using the interactive, system dynamics, and role play simulation over those using the discussion method

Table 5: One-way ANOVA of the Post Test Scores on the 4 Group

Source	Df	SS	MS	F-Ratio	F- Cri	Decision
Between groups	3	3125.069	1041.690	6.389	2.65	Reject H02
Within Groups	156	25435.925	163.051			
Total	159	28560.994				

Table 5, null hypotheses 2 was rejected at 0.05 level of significance, indicating that, there was no significant difference in the use of simulation instructional methods (Interactive, role-play and system dynamics) over the discussion method on secondary school student's academic performance in Physics.

H03: There is no significant difference in the interest of SS2 students taught Physics using the interactive, system dynamics, and role play simulation over those taught using the discussion method.

Table 6: Summary of, one-way ANOVA in the Post Interest scores of students taught Physics using the Interactive, System Dynamic, Role-play over the Discussion Group

Source	SS	Df	MS	F	Sig	F	Decision
Between Group	2669.319	3	889.773	6.591	.000	2.65	Reject H03
Within group	21058.425	.156	134.990				
	23727.744	159					

Table 7: Summary of the Scheffe Multiple Comparison on the difference between the mean interest scores of students taught Physics using the Interactive, System Dynamic, Role-play over the Discussion Group

VAR 2	VAR 2	Mean Diff	Std Error	Sig	Lower Bound	Upper bounds
Interactive	System dynamics	2. 75000	2.99807	.829	-5.7233	11.2233
	Role play	11.7000	2.99807	.002	3.2267	20.1733
	Discussion	11.47500	2.99807	.003	3. 0017	19. 9483
System dynamic	Interactive	-2.75000	2.99807	.839	-11.2233	5.7233
	Role play	8.95000	2.99807	.034	.4767	17.4233
	Discussion	8.72500	2.99807	.041	.2517	17.1985
Role-play	Interactive	-11.7000	2.99807	.002	-20.1733	-3.2267
	System dynamics	-8.95000	2.99807	.034	-17.4233	-4.767
	Discussion	-22500	2.99807	1.000	-8.6983	8.2483
Discussion	Interactive	-11.47500	2.99807	.003	-19.9483	- 3.0017
	System dynamics	-8.72500	2.99807	.041	-17.1983	- 2517
	Role play	.2250	2.99807	1.000	-8.24838	8.6983

The null hypothesis was of no significant difference in interest on the use of the simulation instructional method (interactive, system dynamic, role-play simulation) over the discussion method on academic performance. Therefore, Physics students taught using the interactive method had the highest increase compared to the discussion method regarding academic performance.

Discussion

The experiment showed that the discussion method unfolded a higher level of interest than other forms of simulation because the discussion method activated students' interest towards processing information rather than simply receiving it. This finding was in line with Bello et al. (2019), who examined the effect of simulation technique and discussion method on students' academic performance and interest in Mafoni Day Secondary

School, Maiduguri, the study showed that students exposed to the discussion method did better than those exposed to the simulation method. Odo and Odo's (2016) findings also affirmed this result, on the effect of the simulation method on students' interest in programming language in secondary schools in the Enugu education zone of Nigeria, revealing that the interest of students taught using the simulation method was higher than those taught using the discussion method.

The interactive simulation was found to be the highest, in assessing the academic performance of Physics students when compared to others as the findings revealed that, the interactive simulation had the most effective simulation instruction, next was the system dynamics, discussion method and role-play simulation. The findings were in line with, Ukoh and Dibie (2020) who focused on classroom participation and interest in determinants of students' academic performance in Physics among secondary school students in Osun state.. The academic performance of students taught Physics, using the interactive simulation was found higher than those using the system dynamics, role-play simulation and discussion method. The findings of the study revealed that a significant relationship existed, between classroom academic performance and students' interest in Physics, in line with Amadi (2021) who decoyed laziness as one of the causes of failures in external examinations on Physics. The scholar frowned at the resistant and saboteur teachers that miss the mark of including technology in their teaching practices and affirmed that the gap that existed in communication with their students must be closed as such anomalies must be breached.

Conclusion

The study has shown that the simulation methods in interactive, system dynamics and role play have improved students' academic performance and thrilled students in freeways to communicate effectively and have acted as a good influencer for Physics students to partake in fashionable ways in comprehending through interpersonal relationships with teachers and students.

Recommendations

1. Adequate and standard technological facilities should be provided to steer up the interest of students in the use of simulation as a supportive resource material, to stir up the interest of Physics students while the discussion method should be backed up through the use of visuals in direct communication and interaction with students.
2. Adequate public relationships among teachers and students should be accentuated to sensitize the duos across the diaspora, especially the African countries on strengthening consensual ties through the transfer and impact of knowledge, on Physics through the use of simulation.
3. Developed countries like Nigeria should learn to invest more in innovative techniques in the teaching and learning of Physics for the sustenance of educative Physics communication through collaboration amidst students.

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