

Impact of Gaminification on Students Academic Performance in Basic Science and Technology in Junior Secondary Schools in Ondo State, Nigeria

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Abstract

The study examined the impact of gaminification on secondary school students' academic performance in Basic Science and Technology (BST) in Ondo State. The study adopted pretest -posttest control group quasi experimental research design. The population of the study consisted of all Junior secondary school students in Ondo State. While the sample population consisted of 120 Junior Secondary School (JSS) Students randomly selected from four secondary schools in Akure South local government area of Ondo State. Three objectives and three hypotheses were set and formulated for the study respectively. Two instruments were used in the study, they are; (i) Basic Science and Technology Students' Performance Test (BSTSPT) and (ii) Instructional Game Package (IGP). Intact classes were used in all the sampled schools. The participants were divided two groups (experimental and control). The experimental groups were taught with IGP. While the control groups were taught with Conventional Teaching Method (CTM). The data were analyzed using Analysis of Covariance (ANCOVA). The results revealed that students taught with IGP performed significantly better than their counterparts taught with the conventional teaching method. The study also shows that there was no significant difference between the academic achievements of male and female students taught with IGP. The findings further revealed that there was no significant difference between urban and rural BST students' academic achievement taught with IGP. Based on the findings, it was recommended that the use of IGP should be encouraged in secondary schools. Both male and female students should also be motivated further to use IGP in secondary schools. Also, it was recommended that both rural and urban schools should be encouraged to use IGP for instructions in school subjects particularly in Basic Science and Technology.

Keywords: Gaminification, instructional game package, conventional teaching method, secondary school, Basic science and technology

Introduction

Basic Science and Technology (BST) as one of the core subjects in Junior Secondary School curriculum in Nigeria, comprises of elements from biology, physical and health education, information technology, life sciences, environmental, chemistry, physics and introductory technology. The subject is concerned with finding out about things in

the environment, developing the individual for well-rounded life through well-rounded education with adequate resources (Oyekekan & Adewale, 2014). The subject presents science as a systematic body of knowledge about man, science and technology, space and phenomena (Chen & Howard 2010).

The aim of the Basic Science and Technology (BST) curriculum in schools is not only to transmit data and principles as in contemporary science and technology, but also to help learners perform well and acquire skills with which to tackle the challenges of life and continue life-long learning. The Nigerian Educational Research and Development Council (NERDC, 2007) further identified major relevance of the subject in the school curriculum as including; helping the learners to develop interest in science and technology, acquisition of basic knowledge and skills in science and technology, application of scientific and technological knowledge and skills to meet societal needs, exploring and taking advantage of the numerous career opportunities offered by science and technology, and becoming prepared for further studies in science and technology.

Despite all these relevance of Basic Science and Technology in the school curriculum, literatures such as Aderele and Abidoye (2022) claimed that the teaching of the subject still characterized with the use of conventional method of teaching which does not give room for active participation of learners in the teaching and learning of the subject. They stated further that conventional method of teaching is teacher centred in nature. The use of this inappropriate method of teaching often leads to poor academic achievement of learners in the subject. However, in the quest to discover new ways of facilitating effective teaching and learning of Basic Science and Technology (BST), there is great need to foster innovative and technology-based teaching strategy aimed at improving students' interest and academic performance in the subject. One of such innovative and technology-based strategies that can be effectively used for teaching of BST and improving students' academic performance in the subject is gamification instructional strategy (Papasteriou 2019).

Gamification according to Daniel (2011) is the integration of gaming dynamics in non-gaming environments. Hanus (2015) also refers to gamification as the process of employing game components (like points scoring, competition, rewards system and other principles of game play) in a non-game situation to stimulate engagement and

motivate participants to achieve a desired goal or behavior. Games and game elements have been used as tools for learning as they help simulate real-life situations in safe and often entertaining environment and they often tend to engage players and participants so much that they are emotionally immersed in the process, thereby enjoying the task and challenges it offers.

The use of games particularly for instruction can encourage learners to build relationships with the environment, express emotions, gain experiences, have a good time, relax and find solutions to the problems (Daniel 2011). Hanus (2015) posits that gamification fosters learner motivation and generally helps learners receive positive feedback during teaching process. Papasteriou (2019) also claims that games lead learners to display positive attitude and have positive influences over success. Siegler & Ramani, (2018) avert that games have always been effective tools to draw the attention of learners towards the learning content in the class.

Gender differences is one of the factors that affect the use of technology in teaching and learning process. Gender refers to the socially constructed characteristics of women and men – such as norms, roles and relationships between male and female (Aderele and Abidoye 2022). Abidoye & Abidoye (2022) also describes gender as the socially and culturally constructed characteristics and roles which are ascribed to males and females in any society. He described the male attributes as bold, aggressive, tactful, and efficient in the use of words while the females are fearful, shy, gentle, dull, submissive and effusive. In the same vein, Umoh (2003) stated that more complex works are usually set aside for male, while the females are considered womanly in a natural setting. Damia (2014) concluded that there was a significant effect of gender on students' academics self-concept in favour of the female students than their male counterparts.

Another learning characteristic that can influence students' academic achievement in Basic Science and Technology is school location. School location could either be urban or rural. The urban environment can be conceptualised as that which has high population density, contains a high variety of beautiful commonplace views and enough social amenities, whereas the rural environment is characterized by low reports that school location in favour of urban centres has significant effect on student attitude towards mathematics and chemistry and any other school subjects.

Statement of the Problem

The problem of persistence low academic performance in Basic Science and Technology (BST) by secondary school students has been a major concern to educators. Researchers such as Aderole and Abidoye (2022) have identified a number of possible contributing factors to this issue, including the teaching strategies employed by teachers. In particular, the traditional "chalk and talk" method, which involves the teacher talking to students while writing notes on the board, has been criticized for its lack of interactivity, ability to engage and motivate students, and its inability of equipping students with the necessary scientific skills and mindset. However, a more effective technology-based learning strategy that is learner-centered and activity based needs to be explored for the teaching and learning of Basic Science and Technology. One of such technological-based instructional strategies that can enhance students' academic performance is Gamification (Hanus (2015). However, literatures have revealed that as at the time of carrying out this research, there were little researches on the effectiveness of Gamification in the teaching and learning of Basic Science and Technology especially in Akure South local government area of Ondo State. Hence, this research examines the impact of Gamification on students' academic performance in Basic Science and Technology in Junior Secondary Schools in Ondo, Nigeria.

Objectives of the study

The study aims at achieving the following objectives:

1. to determine the effect of gamification on secondary school students' academic achievements in Basic Science and Technology.
2. to determine the effect of gender differences on secondary school students' academic achievements in Basic Science and Technology.
3. to determine the effect of school location on secondary school students' academic achievements in Basic Science and Technology.

Hypotheses of the Study

HO1: There is no significant effect of treatment on students' academic performance in Basic Science and Technology.

HO2: There is no significant effect of gender on the students' academic performance in Basic Science and Technology.

HO3: There is no significant effect of school location on students' academic performance in Basic Science and Technology.

Methodology

This study adopted pretest-posttest, control group quasi, experimental research design. The sample population for this study consisted of 120 Junior Secondary School 2 (JSS2) students from four schools randomly selected in Akure South Local Government. Purposive sample technique was used to select the sample schools. Schools that have functional ICT laboratory and facilities were selected for the study. Intact classes were used in all the sampled schools. Two schools sampled for experimental and two schools were sampled as the control groups. Two instruments were used in the study. They are; Basic Science and Technology Students' Performance Test (BSTSPT) and Instructional Game Package (IGP). All the instruments were validated by experts. The experimental groups were taught Basic Science and Technology with the use of IGP, while the control groups were taught with the use of conventional teaching method. All hypotheses were tested using ANCOVA statistical tool at 0.05 level of significance.

Results

Ho1: There is no significant main effect of treatment on students' academic performance in Basic Science and Technology.

Table 1. Summary of Analysis of Covariance (ANCOVA) on Students' Performance in Basic Science and Technology

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9157.469 ^a	8	1144.684	14.849	.000	.517
Intercept	16552.420	1	16552.420	214.719	.000	.659
Pretest	3.438	1	3.438	.045	.833	.000
Treatment	8577.454	1	8577.454	111.267	.000	.501
Location	21.354	1	21.354	.277	.600	.002
Gender	82.257	1	82.257	1.067	.304	.010
Treatment * Gender	102.575	1	102.575	1.331	.251	.012
Error	8556.856	111	77.089			
Total	408621.000	120				
Corrected Total	17714.325	119				

Dependent Variable: Students' Achievement in Basic Science and Technology (posttest)

R Squared = .517 (Adjusted R Squared = .482)

Table 1 reveals, that there is significant main effect of treatment (gamification) on the students' academic performance in Basic Science and Technology ($F(1, 111) = 111.267$; $p < 0.05$; partial $\eta^2 = .501$). The treatment effect size is 51% (partial $\eta^2 \times 100$). This result means that there is significant difference in the post-performance mean scores of the students due to the treatments. Hence, hypothesis 1 is rejected. In order to determine the mean difference across the groups, the Estimated Marginal Means of the treatment group were carried out and the result is presented in Table 2 below.

Table 2: Estimated Marginal Mean on Students' Achievement, across the Groups Variables

Variables		N	Mean	Std. Error
INTERCEPT	Pretest	120	42.78	-
	Posttest	120	57.47	.82
TREATMENT	Experimental Group	57	66.12	1.189
	Control Group	63	48.84	1.125
GENDER	Male	53	56.61	1.226
	Female	67	58.33	1.105
LOCATION	Urban	65	57.03	1.134
	Rural	55	57.91	1.203

Table 2 reveals that the mean score for the performance of the students before the experiment was 42.78 while it became 57.47 after the experiment. The table shows further that the students exposed to Basic Science and Technology lessons through gamification had better performance (= 66.12) than those in the control group (= 48.84). Again, the table shows that the male participants had lower achievement (= 56.61) than the female ones (= 58.33). Also, from the table, it was revealed that students from both Urban and Rural had almost the same performance with (= 57.03) and (=57.91) respectively. This result implies that the Gamification is highly effective in improving students' performance in Basic Science and Technology.

Ho2: There is no significant main effect of gender on the students' academic performance in Basic Science and Technology.

Also from table 1, it was observed that there is no significant main effect of gender on students' performance in Basic Science and Technology ($F(1, 111) = .067$; $p > 0.05$; partial $\eta^2 = .010$). The effect size is 10%. This means that gender does not have any significant effect on the students' performance scores' when using gamification instructional approach in learning Basic Science and Technology. Hence, hypothesis 2 is retained.

Ho3: There is no significant main effect of school location on students' academic performance in Basic Science and Technology.

From table 1, there is no statistically significant effect of school location on students' academic performance ($F(1, 111) = .277$; $p > 0.05$; partial $\eta^2 = .002$). The effect size is 0.2%. This means that school location does not have any significant effect on the students' academic performancescores' when using gamification instructional approach in learning Basic Science and Technology. Hence, hypothesis 3 is retained.

Discussion

The finding of this study revealed that there is significant difference between the academic performance of Basic Science and Technology students taught with Instructional Game Package (IGP) than their counterparts taught with conventional teaching method. This could be because the use of IGP helped students to have better understanding of learning contents which led to the improvement in their academic performance. This finding is consistent with the findings of Nwachukwu & Johnson (2020) who reported that the use of gamification improved academic performance of Junior Secondary school students in Basic Science in River state, Nigeria.

It was also revealed from this study that there was no significant difference between male and female students' academic performance taught with Instructional Game Package. This implies that students whether males or females are similar in using IGP. This is in line with the finding of Elian and Hamaidi (2018) who revealed that there was no differences in male and female academic achievements when taught with mobile phone instructional package.

Findings on the effect of school location on the academic performance of students taught with Instructional Game Package revealed that school location has no significance effect on students' academic performance. This finding is against the finding of Mouza (2008) who

finds out that students from urban environment performed consistently higher than the students in the rural schools.

Conclusion

The study focused on the need to improve the teaching and learning of Basic Science and Technology in Junior Secondary Schools through the use of Instructional Game Package. The findings of the study revealed the superiority of Instructional Game Package to conventional teaching method of teaching Basic Science and Technology (BST) in the sense that it has led to significant difference in the students' academic performance in Basic Science and Technology.

Recommendation

Based on the findings of this study, the following recommendations were made;

1. Secondary school teachers especially Basic Science and Technology teachers should be educated through seminars, workshops, and training on the instructional benefits of gamification especially IGP and be encouraged to optimized these benefits for total instructional delivery in secondary schools.
2. Training and workshops should be organized for secondary school teachers on the use of Instructional Game Package.
3. iii State ministries of education, the federal government and NGOs should provide schools with necessary infrastructures and financial supports that will encourage the use of game-based instructional strategies in schools especially secondary schools.

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