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NWOKOCHA, N. B; ZUBAIRU, S. A.; DADA, A. A.; & ABU Yusufu

Department of Educational Foundations and Curriculum, Instructional Technology Section, Ahmadu Bello University, Zaria, Nigeria.

nkybenadeth@gmail.com

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Abstract

This study investigated the effects of edutainment augmented with Think-Pair-Share (TPS), Reciprocal Peer Teaching (RPT) and Think Aloud Pair Problem Solving (TAPPS) collaborative settings on the academic performance and attitude of senior secondary students taught biology. The study employed a quasi-experimental design comprising of pretest, posttest and retention test using non-equivalent and non-randomized groups. The population for the study was the entire 63 public secondary schools in Abuja of which three sample schools were selected using purposive sampling techniques. Each school was randomly assigned to TPS, RPT and TAPPS collaborative setting. The edutainment simulation instructional package was administered to the three groups and the performance and attitude of the students were measured at pretest and posttest with the aid of the Biology Achievement Test (BAT) and the Attitude towards Biology Questionnaire (ATBQ) items. Findings revealed that the use of edutainment package significantly increased the performance of students. Results from ANCOVA analysis revealed that all three collaborative settings had similar effects on the performance of the students. This study also revealed that the use of edutainment resulted in better retention scores for students. Thus, it is recommended that schools adopt the use of edutainment teaching strategies.

Introduction

Science education has been recognized as a veritable tool in national development and this has found a central place in the curricula of schools at all levels. Biology is a branch of science subjects offered at senior secondary schools in Nigeria. It takes a central position in science and technology. Biology curriculum is designed to encourage students' ability to apply scientific knowledge in everyday life (Federal Ministry of Education, 2009). Furthermore, the importance of Biology as a secondary school subject can be further illustrated by the fact that any candidate seeking for university admission must obtain a credit pass to study courses like Medicine, Pharmacy, Laboratory Science, Biochemistry, Microbiology, Food Technology, and Biology Education among others (Ihejiamaizu & Ochui**,** 2016).

In spite of the importance of biology as a subject, students' performance at senior secondary school level has been poor (WAEC Chief Examiners Report 2008 – 2016; Ezenwosu, & Nworgu, 2013; Ihejiamaizu & Ochui, 2016). This is also evident in the overall poor performance of students in the subject internal examination based on the randomly collated WASSCE results by the researchers from 12 public senior secondary schools in Abuja from 2013–2017. Findings by the researchers revealed that less than 30% of students passed biology in 2013 and 2014 while less than 50% passed the subject from 2015 onwards.

Studies have shown that Biology teachers do not always employ effective instructional approaches in teaching the subject (Okoyefi, 2014). This might have led to situations where some students cannot apply the knowledge of biology into real-life situations. In most secondary schools in Nigeria, teachers employed conventional teaching method that requires giving little explanations or demonstrations while students usually focus on textbook reading, note taking, and memorization of facts (Yassanne, 2014). Several types of research attribute the poor performance to inadequate, inappropriate and perhaps non-utilization of the available laboratory equipment in teaching and learning biology (Agboghoroma & Oyovwi, 2015; Ihejiamaizu & Ochui, 2016). The abstractness of certain aspects of Biology and lack of understanding of certain biological concepts such as ecology were also responsible for students' poor performance (Nzelum, 2010; Adekunle & Femi, 2016). Usman (2010) emphasized that the present mode of teaching Biology in secondary schools where teachers adopt only the lecture method does not provide for the sequence of learning experiences. This may have led to poor performance in the subject. Hence, the quality of teaching which the students were receiving has contributed to their decline interest and performance in science (Leever, 2010). The persistent use of this method makes students passive rather than active learners (Angadi & Ganihar, 2015). It does not promote insightful learning and long–term retention of some abstract concepts in biology (Ahmed & Abimbola, 2011; Umar, 2011). The need for teachers to adopt new instructional approaches (using the computer) that deviate from the conventional approach presently being used becomes necessary.

Kareem, (2015) noted that computer can expand pedagogical resources available to teachers in the science classroom thus supporting teaching. Furthermore, the use of computers in the classroom can help students' complete assigned tasks effectively and efficiently. Hence, computer technology has the potential to foster students' abilities, revolutionize the way they work, think, and learn. The increase in digital technology applications such as playing computer games or watching videos has become a routine activity of students today. Students prefer to learn in a conducive environment by combining education with entertainment – edutainment.

Edutainment, like infotainment, technotainment, educational electronic games, is a new term coinage (Santonen; Teemu & Faber 2015). The idea underlying edutainment is to promote learning by merging educational contents and entertainment activities that increase engagement, emotion, and motivation (Aksakal, 2015). According to Oksana & Elena (2015) and Pakprod & Wannapiroon (2014), edutainment is a hybrid game genre that relies heavily on visuals and narratives or game formats but also incorporates some type of learning objective. Edutainment, therefore, is engaging entertainment and media-based materials to promote the learning process (Zuhal, 2017). In edutainment, digital information such as text, images, and video are layered and blended into the perception of the real world (Falode, 2016). Edutainment makes students learn while they have fun. Edutainment offers students a way to wander through stories, information, or games at their own pace and in their own way (Aksakal, 2015). In this study, edutainment is a computer (augmented) package of video games/simulation, audio (CD/ Cassette) and computer game (animation) in which students can learn while they are playing and thereby improve their ability to learn Biology.

Furthermore, this study augmented edutainment with collaborative learning environments. Collaborative learning can be viewed as education through the exchange of ideas that combine technological techniques. These techniques may include open discussion, people in small groups may have collective thinking, learn to mobilize energy and actions toward common goals, and rely on intelligence that is superior to the sum of the individual talents of the members of the group (Gambari, Obielodan & Kawu, 2017). Collaborative learning brings together many perspectives to solve a problem, engaging students in relevant learning around an authentic question. It allows students to work together toward a common purpose to explore, make meaning, and understand the world around them (Scott, 2015, Telima & Omeodu, 2016). This study augmented edutainment with three collaborative learning settings; Think-Pair Share (TPS), Reciprocal Peer Teaching (RPT) and Think-Aloud Pair Problem Solving (TAPPS) respectively.

Methodology

The research design for the study is a quasi-experimental design comprising of pretest, posttest and retention test using non-equivalent and non-randomized groups (Nworgu, 2015). The study employed a previously developed edutainment instructional package (Nwokocha, Gambari and Tukur, 2020). The edutainment instructional package is a simulation and game that covers the concepts of ecology. The instructional package was augmented with Think-Pair Share (TPS), Reciprocal Peer Teaching (RPT) and Think-Aloud Pair Problem Solving (TAPPS) collaborative instructional strategies in three different senior secondary schools in Abuja, Nigeria.

The target population for this study consists of the entire public senior secondary school class one (SS I) Biology students from the 64 public senior secondary schools in Abuja. The number of students was obtained to be 10,223. A three-staged sampling technique was adopted in the sample selection process. First, a purposive random sampling technique was adopted to obtain three secondary schools in Abuja, FCT. These schools were purposively sampled based on equivalence (laboratories, facilities, and manpower), school type (public schools), ICT equipment (computer laboratories under the SchoolNet programme), exposure (students and teachers' exposure to the use of computer in their schools), and candidates' enrolment (enrolling students for SSSCE Biology examination for a minimum of ten years). Secondly, the three selected schools were randomly assigned to the three augmenting collaborative learning settings using a simple random sampling technique. One school each was assigned to TPS, RPT, TAPPS groups. Lastly, since only one intact class was to be used for the study, one arm (stream) of the Biology SS 1 classes was randomly selected using a simple random sampling technique.

The research instruments include the edutainment instructional package, Biology Achievement Test (BAT) and the Attitude towards Biology Questionnaire (ATBQ). All research instruments were developed and subsequently validated subject matter experts and were subsequently used in pilot studies that confirmed their suitability for the intended research. Students in the three groups (i.e., TPS, RPT, and TAPPS) were subjected to BAT and ATBQ at pretest and posttest conditions. BAT was subsequently administered to the students six weeks after posttest conditions to measure students' retention of concepts taught. The questions in BAT were shuffled before they were administered to the students each time.

The data collected was subjected to both descriptive and inferential statistics. Graphical representations were used to present the mean scores of the students at pre-, post- and retention tests. Analysis of covariance (ANCOVA) at $p \leq .05$ was used to compare the achievement and attitude of students at pretest posttest and retention test. All statistical tests were carried out using the Statistical Package for Social Sciences (SPSS) version IBM 26.

Results

The performance (pretest, achievement, and retention) scores of the students are as presented in Figure 1. Students in all groups experienced an increase in achievement scores at posttest conditions. This resulted in positive mean gains in their performance. Students in the RPT group recorded a mean gain of 47.06 while those in TPS and TAPPS recorded a gain of 47.06 and 46.43 respectively.

The retention scores of students in all groups were less than their posttest scores but were higher than the pretest scores. This resulted in a mean loss in performance scores between posttest and retention test conditions. Students in the RPT group experience the highest mean loss in performance scores with a value of 25.67. Students in the TAPPS and TPS groups had mean losses of 19.72 and 19.54 respectively.

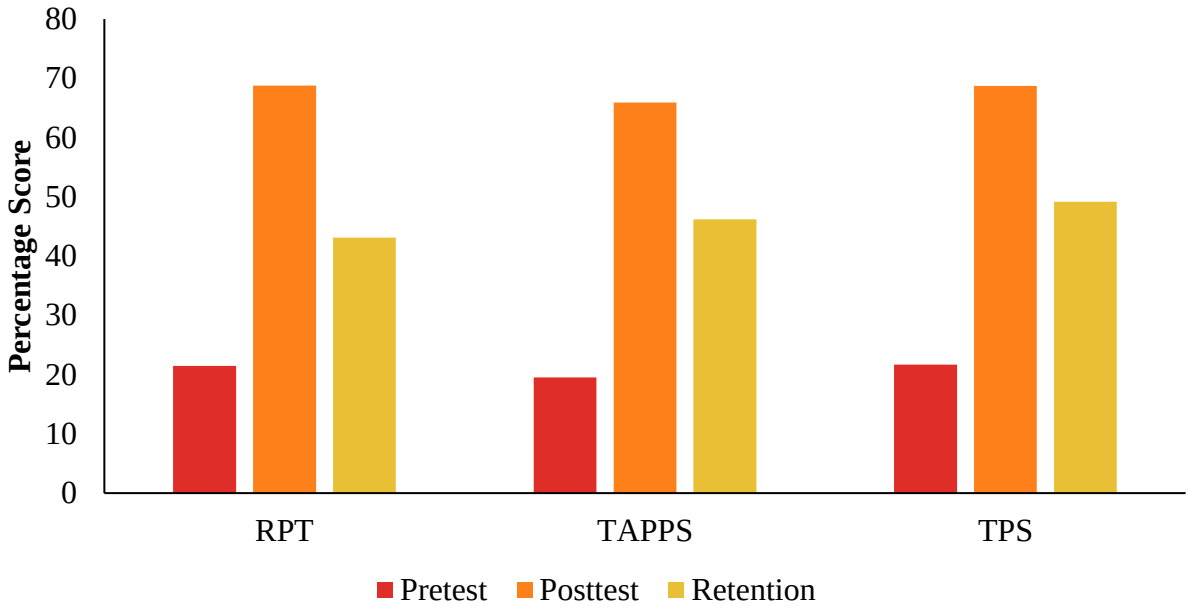

Figure 1: Pretest, posttest, and retention scores of students

To investigate if the use of edutainment augmented with RPT, TAPPS and TPS collaborative settings had a significantly positive effect on the posttest achievement scores of the students, an analysis of covariance (ANCOVA) test was carried out at a 95% confidence level. The results is as presented in Table 1

Table 1: ANCOVA test on achievement of students taught biology using edutainment augmented with collaborative settings

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6038.493[a]	3	2012.831	26.681	.000
Intercept	4145.690	1	4145.690	54.953	.000
Pre-test	5846.479	1	5846.479	77.497	.000
Groups	15.821	2	7.910	.105	.901[ns]
Error	7166.921	95	75.441		
Total	465828.000	99			
Corrected Total	13205.414	98			

ns: Not significant at $p < 0.05$

Table 1 presents the result of the ANCOVA test investigating the effects of edutainment augmented with RPT, TAPPS and TPS collaborative setting on students' posttest achievement scores. From the result; $F(3, 99) = 0.105$, $p = .901$. This finding implies that although edutainment teaching strategy has a positive effect on the scores of the students (Figure 1), its effect is similar in all three collaborative groups. The result implies that edutainment teaching methods has similarly positive effects irrespective of the collaborative method employed.

To investigate if the use of edutainment augmented with RPT, TAPPS and TPS collaborative settings had a significantly positive effect on the retention achievement scores of the students, an analysis of covariance (ANCOVA) test was carried out at a 95% confidence level. The results is as presented in Table 2

Table 2: ANCOVA test on retention of students taught biology using edutainment augmented with collaborative settings

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1045.343[a]	3	348.448	2.678	.051
Intercept	115.848	1	115.848	.890	.348
Posttest	867.055	1	867.055	6.663	.011
Treatment	155.608	2	77.804	.598	.552
Error	12362.839	95	130.135		
Total	463465.000	99			
Corrected Total	13408.182	98			

a. R Squared = .078 (Adjusted R Squared = .049)

Table 2 presents the result of the ANCOVA test investigating the effects of edutainment augmented with RPT, TAPPS and TPS collaborative setting on students' retention scores. From the result; F (3, 99) = 0.598, p = .552. This finding implies that although edutainment teaching strategy has a positive effect on the retention scores of the students (Figure 1), its effect is similar in all three collaborative groups. The result implies that edutainment teaching methods has similarly effects on students' retention scores irrespective of the collaborative method employed.

The pretest and posttest mean attitude of students towards biology was calculated and results are as presented in Figure 2. From the result, it can be deduced that there is difference between the pretest and posttest mean attitude that accounted for a positive mean attitude change for all treatment groups in favor of the posttest. This implies that students in all three groups had a more positive attitude towards the biology at posttest compared to pretest. Furthermore, all treatment groups had similar posttest mean attitude and mean attitude change; thus, it implies that all three treatments had similar effects on the students.

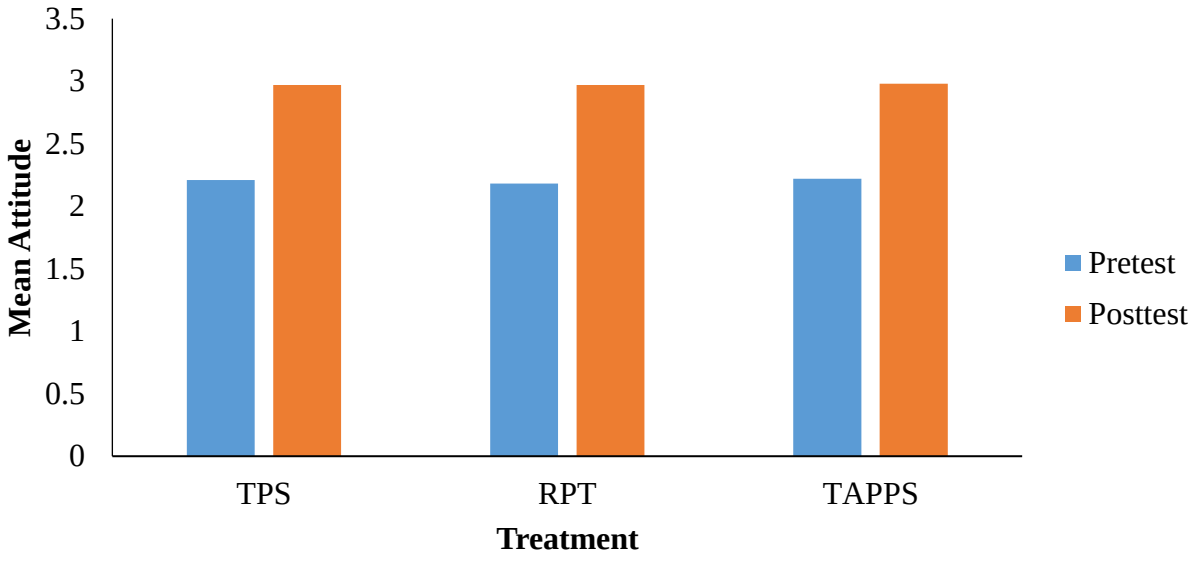

Figure 2: Mean attitude of students taught biology using edutainment augmented with TPS, RPT and TAPPS strategies

The effects of edutainment augmented with RPT, TAPPS and TPS collaborative settings on the attitude of students towards biology was investigated using an ANOCOVA test. The results is as presented in Table 3.

Table 3: ANCOVA test on attitude of students taught biology using edutainment augmented with collaborative settings

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.005[a]	3	.002	.207	.892
Intercept	.719	1	.719	90.451	.000
Pretest Attitude	.003	1	.003	.424	.517
Treatment	.001	2	.000	.037	.964
Error	.755	95	.008		
Total	874.147	99			
Corrected Total	.760	98			

a. R Squared = .006 (Adjusted R Squared = -.025)

Table 3 presents the result of the ANCOVA test investigating the effects of edutainment augmented with RPT, TAPPS and TPS collaborative setting on students' attitude towards biology. From the result; F (3, 99) = 0.037, p = .964. This finding implies that although edutainment teaching strategy has a positive effect on the attitude of the students (Figure 2), its effect is similar in all three collaborative groups. The result implies that edutainment teaching methods has similarly positive effects on students' attitudes towards biology irrespective of the collaborative method employed.

Discussion

The effects of edutainment augmented with instructional packages (Think-Pair-Share, Reciprocal Peer-Tutoring and Think Aloud Pair Problem Solving) in collaborative settings for the teaching and learning of Biology on Senior Secondary School students' performance was investigated in this study. Among the findings of this study is that use of Edutainment Augmented with Instructional packages, Think-Pair-Share (TPS), Reciprocal-Peer-Tutoring (RPT) and Think-Aloud Pair Problem Solving (TAPPS) in collaborative settings for teaching and learning of Biology is very effective in improving performances of students in the subject. The RPT collaborative setting was found to be particularly more effective in improving the performances of students in the subject. And in that hierarchy, the use of Think-Pair-Share came next and was followed by TAPPS. The three instructional packages all significantly improved the performances of the students involved in the experiment. The observed differences in improved performance by the different instructional packages was not statistically significant. The finding here is consistent with Okoyefi, (2014) who opined that emphasis should be placed on the teaching and learning process in other to allow students to develop their highest potentials. The findings are in line with the postulation of Pakprod & Wannapiroon (2014) and Zuhal, (2017), who respectively reported that edutainment is a hybrid game genre that relies heavily on visuals and narratives or engaging entertainment and media-based materials to promote the learning process that incorporates some type of learning objectives.

This study also found that the use of Edutainment Augmented with Think-Pair-Share (TPS), Reciprocal-Peer-Teaching/Tutoring (RPT) and Think Aloud Pair Problem Solving (TAPPS) in collaborative settings for teaching and learning of Biology has major effects on improving the retention ability of students involved in the experiment. All three instructional packages had positive effects on the retention ability of the students after their respective exposure. However, there was no significant difference in their effects on the students' retention. This finding agreed with Nusair, Sharma & Khan (2013). They reported that Edutainment is a very interesting combination of traditional content and teaching methods in the context of new technologies. Thus, it is viewed as a promising avenue of communication for development and enhancement of student experiences that can help to create a more positive, effective environment for learning as it increases students' achievement and knowledge retention in subject topics.

Lastly, this study found that use of Edutainment Augmented with instructional packages (Think Pair-Share, Reciprocal-Peer-Tutoring and Think-Aloud Pair Problem Solving) in collaborative settings for teaching and learning of Biology has positive improvement on attitude of students towards the subject. It was found that use of Edutainment Augmented with the Instructional packages enhances their preferences for instructions and presentations of concepts among others. Mean attitudinal difference between the RPT, TAPPS and TPS groups towards the teaching and learning of the subjects did not differ significantly. The finding here is consistent with the finding of Ahmad & Asghar, (2015) who reported that students' attitude towards biology are not affected by gender. The finding agreed with Khalil and Shaheen (2017) who conducted a study that strengthened the notion that students' achievements in the field of science were linked with their attitudes towards science.

Conclusion

This study revealed that the use of edutainment augmented with reciprocal-peer-tutoring, think-pair-share and think-aloud pair problem solving collaborative settings significantly increases the academic performance of students taught biology. Students in all collaborative settings were observed to attain significantly higher performance scores at posttest conditions. The study also revealed that the edutainment instructional package augmented with the collaborative settings improved students' retention scores. Lastly, the use of edutainment instructional methods significantly improved students' attitude towards the teaching and learning of biology.

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