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Effect of Simulation Instructional Package on Upper Basic Science Students' Interest, Achievement and Retention in Body Systems

Ruth Iwanger Samuel[i]
Department of Science, Technology and Mathematics Education,
Faculty of Education, Nasarawa State University, Nigeria.
ruthsa124@gmail.com

Abstract

This study investigated the effect of Simulation Instructional Package on Upper Basic Science Students' Interest, Achievement and Retention in Body Systems. Simple random sampling procedure was employed to select 2 intact classes from 2 public co-education schools in Nasarawa South Senatorial District, Nasarawa State, Nigeria. Quasi experimental research design of non-randomized pretest, posttest, post-posttest time control group design was employed for the study. Two research questions guided the study and two research hypotheses were tested at 0.05 level of significance. Body Systems Interest Rating Scale (BSIRS) and Body Systems Achievement Test (BOSAT) was used as instrument for data collection. The reliability of BOSAT was determined using K-R_{21} formula and the reliability coefficient obtained was 0.85. Descriptive statistics was used to answer the research questions while the hypotheses were tested using Analysis of Covariance (ANCOVA). The findings of this study revealed that significant differences were found in the interest, achievement and retention of students exposed to Simulation Instructional Package compared to that of the Guided Discovery Method. It was recommend based on the findings of this study that, the present conventional method employed by teachers should drastically be minimized and only used in concert with more student-centered approaches.

Keywords: Achievement, Basic Science, Interest, Retention, Simulation and Instructional Package.

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INTRODUCTION

The world today is experiencing a rapid development and every nation is striving to meet up with the requirement needed to attain its development through science. Science education is therefore needed to produce technologists, technicians, scientists, craftsmen and skilled artisans who are required to change the economy which would in turn lead to a rapid growth and development necessary for nations to cope with the present today challenges (Ezeudu & Ezinwanne, 2013).

Science education is therefore a veritable tool for scientific and technological advancement of any nation. This fact is enshrined in the National Policy on Education of the Federal Republic of Nigeria (FRN, 2014) which states that science education should among other things equip students to live effectively in the modern age of science. The policy also emphasized that science and technology teaching and learning are viable instruments for inculcating necessary scientific knowledge, skills and competencies. In order to inculcate the necessary scientific knowledge, skills competencies and attitudes in various developmental strategies such as World Declaration on Education for All (EFA) are put in place in Nigeria educational system. Other strategies like the NEEDS (National Economic Empowerment Development Strategies) and SDGs (Sustainable Development Goals) were put in place. In order to meet these goals, the Nigerian Government overhauled its existing science curriculum to cater for the needs of the nation as it aspires to be among the twenty top economies in the globe by the year 2020 (FRN, 2012).

Basic Science education has become one of the best avenues to meet the global challenges facing the Nigerian nation. Despite the importance of Basic Science in the country's quest for scientific advancement, there has been seeming ineffectiveness in the teaching and learning of the subject which in turn is strongly affecting the attainment of the country's laudable objectives and goals of developing a scientific and technologically literate citizenry. Researchers such as Bukunola and Idowu (2012), Osokoya (2013), Alabi (2014), Oni (2014) Kabutu, Oloyede and Bandele (2015) and Samuel (2017) attests that that poor instructional strategies employed in the teaching of the subjects by teachers contribute to students under achievement. Students find it difficult to understand the basic concepts taught, hence a child that is not well grounded in Science at the basic level, will not show interest in offering core science subjects at the Senior Secondary level.

The main purpose of teaching is to transfer knowledge to the learners. For effective teaching and learning to take place, the teacher needs to use different methods and approaches in teaching. Unfortunately, poor achievement in Basic Science has been attributed to poor approach to teaching employed by teachers (Samuel, 2017; Alabi, 2014; Osokoya, 2013). The present Nigerian Basic Science classroom does not seem to provide hands-on-minds-on challenging, interactive and collaborative environment needed by new generation of students who have been exposed to internet, computer usage, hand-set and other sophisticated gadgets. This problem may best be resolved by the use of simulation instructional package.

Simulations are tools that facilitate learning through representation and practice in a repeatable, focused environment. It helps students to identify and understand factors which control the system and or predict the future behaviour of a system. It can bring into the classroom, aspects of the world or universe that are too expensive, dangerous, abstract, difficult or too slow or too fast in occurrence to be comprehended (Goldsim, 2011). The use of simulations in the teaching and learning of Basic Science and Technology could help the understanding of abstract and difficult concepts by allowing students to develop their own

understanding. Agu and Samuel (2018); Umoke and Nwafor (2014); Ezeudu and Ezinwanne (2013) observed that the use of simulations to teach science gives positive results over time and permits the learner to manipulate variables or parameters and then observe the consequences of their actions.

Interest is considered to be the feeling of an individual towards a particular object or an activity. It means that a child will develop interest in any object or activity that is found to be attractive or stimulating. Therefore, in a classroom situation, the learner will be attentive during a lesson only if the instruction is appealing to the learner (Eriba & Samuel, 2018; Nwachukwu, 2013; Danjuma, 2015).

Achievement is the action of accomplishing an academic task successfully. Its purpose is to find out the stand of a student at a given moment (Akani, 2017). It has to do with testing the knowledge acquired by the student which helps the teacher and the student to evaluate and predict the degree of learning attained. It is useful in testing the retention of information and skill. It is also a determinant of the efficacy and efficiency of a given instruction (Kabutu, Oloyede & Bandele, 2015).

Learning is said to have occurred when what is learnt remains relatively permanent in the mind of the learner. Hence, it is pertinent for students to retain what is learnt. Retention is the capability to replicate the concept learnt when need arises. It is the ability to reproduce a learned behaviour by the learner in due time. Therefore, a learner who repeats an acquired knowledge with less error is said to have retained the material learnt. Similarly, when what is not retained or fades with time, learning becomes incomplete (Asogwa, Muhammed, Asogwa & Ofoegbu, 2016).

The ability of students to recall past learnt Basic Science concepts as an objective of the Basic Science teaching and learning process may likely enhance achievement in the subject. For so long, researchers have been keen on knowing what could be done by teachers to enhance maximum retention of knowledge or skills long after they have been acquired whether in the classroom or outside the classroom (Eriba & Samuel, 2018; Agu & Samuel, 2018; Azuka, 2012). The aim of the present study is to determine the extent to which classroom exposures of students to simulation as an instructional package could enhance Basic Science students' interest, achievement and retention in Body Systems. Specifically, the study sought to find out:

- The effect of Simulation Instructional Package on Basic Science Students' Interest in Body Systems.
- The effect Simulation Instructional Package on Basic Science Students' achievement in Body systems.
- The effect Simulation Instructional Package on Basic Science Students' retention in Body Systems.

Research Questions

- What is the mean interest scores of Basic Science Students taught Body Systems using Simulation Instructional Package compared with those taught using Guided Discovery Method?
- What is the mean achievement scores of Basic Science Students taught Body Systems using Simulation Instructional Package compared with those taught using Guided Discovery Method?

- What is the mean retention scores of Basic Science Students taught Body Systems using Simulation Instructional Package compared with those taught using Guided Discovery Method?

Research Hypotheses

- **H_{O1}:** There is no significant difference in the mean interest scores of Basic Science students taught Body Systems using Simulation Instructional Package and those taught using the Guided Discovery Method
- **H_{O2}**: There is no significant difference in the mean achievement scores of Basic Science Students' taught Body Systems using Simulation Instructional Package and those taught using the Guided Discovery Method.
- **H_{O3}**: There is no significant difference in the mean retention scores of Basic Science students' taught Body Systems using Simulation Instructional Package and those taught using the Guided Discovery Method.

METHODOLOGY

Quasi experimental research design was employed for the study. The sample for study comprised seventy-two Upper Basic II Basic Science students from two intact classes randomly selected from public co-education schools in South Senatorial District, Nasarawa State, Nigeria. The experimental group was taught using Simulation Instructional Package (n=35) while the control group was taught using the Guided Discovery Method (n=37).

Two instruments were used for data collection namely; Body Systems Interest Rating Scale (BSIRS) and Body Systems Achievement Test (BOSAT). BSIRS contained 20 items designed to determine students' interest in Basic Science. BSIRS was rated using a four-point rating scale. The options were: Strongly agree (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points and Strongly Disagree (SD) = 1 point. BOSAT was a 50 item instrument with options A – D that tested the students' knowledge, comprehension, application in Body Systems. The items were allotted 1 mark each, giving total score of 40 marks. The test was validated by experts in Science Education and were trial tested on a representative sample which did not participate in the final study. Kuder-Richardson formula 21 (K-R_{21}) was used to determine the reliability of BOSAT and the reliability coefficient was found to be 0.85 implying that the instrument was reliable enough for the study. Mean and Standard Deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance.

RESULTS

Research Question One: What is the mean interest scores of Basic Science students taught Body Systems using Simulation Instructional Package compared with those taught using Guided Discovery Method?

The mean and standard deviation of students' interest in Body Systems taught using Simulation Instructional Package and Guided Discovery Method are presented in Table 1.

Table 1: Mean and Standard Deviations of Students' Interest Scores Using Simulation Instructional Package and Guided Discovery Method

GROUP	Type of Test	No. of Students	Mean	S.D	Mean Gain
Simulation Package	Pre-test	35	15.00	3.42	
	Post-test	35	29.83	2.78	14.83
Guided Discovery Method	Pre-test	37	13.27	2.34	
	Post-test	37	22.73	3.04	9.46

Table 1 revealed that the mean gain interest score of the Simulation Instructional Package group was 14.83 while the Guided Discovery Method was 9.46. The variation of spread or distance from the mean scores is slightly sparse in the Guided Discovery Method with a (difference of 0.7) than in the Simulation Instructional Package group (with a difference of 0.64) in terms of standard deviation.

Research Question Two: What is the mean achievement scores of Basic Science students taught Body Systems using Simulation Instructional Package compared with those taught using Guided Discovery Method?

The mean and standard deviation of students' achievement in Body Systems taught using Simulations Instructional Package and Guided Discovery Method are presented in Table 2.

Table 2: Mean and Standard Deviations of Students' Achievement Scores Using Simulation Instructional Package and Guided Discovery Method

GROUP	Type of Test	No. of Students	Mean	S.D	Mean Gain
Simulation Package	Pre-test	35	17.55	3.54	
	Post-test	35	27.94	2.41	10.39
Guided Discovery Method	Pre-test	37	16.60	3.85	
	Post-test	37	23.40	3.04	6.80

Table 2 revealed that the mean gain achievement score of the Simulation Instructional Package group was 10.39 while the Guided Discovery Method was 6.80. The variation of spread or distance from the mean scores is slightly sparse in the Guided Discovery Method with a (difference of 0.81) than in the Simulation Instructional Package group (with a difference of 1.13) in terms of standard deviation.

Research Question Three: What is the mean retention scores of Basic Science students taught Body Systems using Simulation Instructional Package compared with those taught using Guided Discovery Method?

The mean and standard deviation of students' retention in Body Systems taught using Simulations Instructional Package and Guided Discovery Method are presented in Table 3.

Table 3: Mean and Standard Deviations of Students' Retention Scores Using Simulation Instructional Package and Guided Discovery Method

GROUP	Type of Test	No. of Students	Mean	S.D	Mean Loss
Simulation Package	Post-test	35	27.94	3.71	
	PostPost-test	35	23.71	2.68	4.23
Guided Discovery Method	Post-test	37	23.40	3.57	
	PostPost-test	37	17.07	2.65	6.33

Table 3 revealed that the mean loss retention score of the Simulation Instructional Package group was 4.23 while the Guided Discovery Method was 6.33. The lower the mean loss, the greater the retention. The higher the mean loss, the lower the retention. The variation of spread or distance from the mean scores is slightly sparse in the Guided Discovery Method with a (difference of 0.92) than in the Simulation Instructional Package group (with a difference of 1.03) in terms of standard deviation.

Hypotheses

H_{O1}: There is no significant difference in the mean interest scores of Basic Science students taught Body Systems using Simulation Instructional Package and those taught using the Guided Discovery Method.

Table 4: Result of Analysis of Covariance on Students' Interest in Body Systems Using BSIRS

Source	Type III Sum of Squares	Df.	Mean Square	F	Sig.
Corrected Model	283.671[a]	2	141.835	16.750	.000
Intercept	702.353	1	702.353	82.945	.000
Pre-interest	25.560	1	25.560	3.018	.000
Group	81.728	1	81.728	31.747	.000
Error	313.304	72	8.468		
Total	29811.000	77			
Corrected Total	596.975	76			

a. R Squared = .475 (Adjusted R Squared = .447)
Significant at P<0.05

Table 4 shows a significant difference between the mean interest scores of students exposed to Simulation Instructional Package and Guided Discovery. F= ratio of 31.747, P<0.05. The null hypothesis of no significant difference was therefore rejected indicating that there was a significant difference in the interest of the two groups.

H_{O2}: There is no significant difference in the mean achievement scores of Basic Science students taught Body Systems using Simulation Instructional Package and those taught using the Guided Discovery Method.

Table 5: Result of Analysis of Covariance on Students' Achievement in Body Systems Using BOSAT

Source	Type III Sum of Squares	Df.	Mean Square	F	Sig.
Corrected Model	28.796[a]	2	14.398	2.090	.135
Intercept	1133.269	1	1133.269	164.504	.000
Pretest	12.456	1	12.456	1.808	.000
Group	15.868	1	15.868	23.303	.000
Error	323.784	72	6.889		
Total	24071.000	77			
Corrected Total	352.580	76			

a. R Squared = .082 (Adjusted R Squared = .043)
Significant at P<0.05

Table 5 shows a significant difference between the mean achievement scores of students exposed to Simulation Instructional Package and Guided Discovery. F= ratio of 23.303, P<0.05. The null hypothesis of no significant difference was therefore rejected indicating that there was a significant difference in the achievement of the two groups.

H_{O3}: There is no significant difference in the mean retention scores of Basic Science students taught Body Systems using Simulation Instructional Package and those taught using the Guided Discovery Method.

Table 6: Result of Analysis of Covariance on Students' Achievement in Body Systems Using BOSAT

Source	Type III Sum of Squares	Df.	Mean Square	F	Sig.
Corrected Model	264.310[a]	2	32.155	15.453	.008
Intercept	646.397	1	646.397	109.618	.000
Post-test	62.781	1	62.781	10.647	.002
Group	64.106	1	64.106	39.601	.001
Error	265.357	72	45.897		
Total	27786.000	77			
Corrected Total	329.667	76			

a. R Squared = .195 (Adjusted R Squared = .159)
Significant at P<0.05

Table 6 shows a significant difference between the mean retention scores of students exposed to Simulation Instructional Package and Guided Discovery. F= ratio of 39.601, P<0.05. The null hypothesis of no significant difference was therefore rejected indicating that there was a significant difference in the retention of the two groups.

DISCUSSION

The findings of this study revealed that the use of Simulations as a medium of instruction has a significant effect on students' interest, achievement and retention in Body Systems. The students taught using Simulation Instructional Package have an increase in interest, achieved and retained significantly than those taught using the Guided Discovery Method. This result is in agreement

with that of Agu and Samuel, (2018), Asogwa, Muhammed, Asogwa and Ofoegbu, (2016), Umoke and Nwafor (2014) and Ezeudu and Ezinwanne (2013). They found out that the use of Simulation Instructional Package to teach science enhances achievement and could give positive results over time. The trend of high interest, achievement and retention by the treatment (Simulation Instructional Package) group could be as a result of remedial activities provided for the students as they were actively involved in the experiential learning.

Another revelation of this study was that the standard deviation scores for both the treatment and control groups were moderate and not at much variance implying that the efficacy of the treatment was sustainable. The probability of the methods discriminating across other moderator variables could be ruled out. That is to say that the Simulation Instructional Package is not only efficient but also stable in fostering students' interest, achievement and retention in Basic Science.

CONCLUSION

The findings of the study, among others have shown that using Simulation Instructional Package is a way of improving interest, achievement and retention in Basic Science at the Upper Basic School level in Nigeria.

Recommendations

- Basic Science teachers should be encouraged to adopt Simulation Instructional Package as means of instruction to enhance the teaching and learning of Basic Science. This is because it is an innovative approach and have the potential to motivate learners towards learning Science and Technology.
- Government should set up special centres to develop Simulation Packages or softwares on abstract topics in Science for the purposes of enhancing instruction in schools.

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[i] **Ruth Iwanger Samuel** is a post graduate student in the Department of Science, Technology and Mathematics Education, Faculty of Education, Nasarawa State University, Nigeria. She can be reached via email at ruthsa124@gmail.com.