Effects of Instructional Simulation on Students' Academic Performance in Basic Science in Junior Secondary School in Ekiti State, Nigeria

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ABSTRACT *The study investigated the Effects of instructional simulation on students' academic performance in Basic Science in junior secondary school in Ikere local government area, Ekiti State, Nigeria. The research design adopted in the study was Pretest-Posttest Quasi- experimental. The sample for the study was 160 junior secondary school Two (JSS II) basic science students, selected through the simple random sampling technique from four junior secondary schools in Ikere local government area, Ekiti State, Nigeria. The instrument used to collect relevant data from the subjects was Basic Science Achievement Test (BSAT) and the treatment package used for the study was tagged: Simulation Instructional Package (SIP). The reliability of the instrument was determined through the split-half method with the reliability coefficient of 0.82. Two null hypotheses were tested at 0.05 level of significance. The data collected were analysed using t-test and Analysis of Covariance (ANCOVA) statistical analysis. The results of the analyses showed that there was significant difference in the academic achievement of students in basic science in the experimental and control groups in favour of experimental group. Based on the findings of the study, it was concluded that simulation activities teaching approach is more potent in stimulating students' academic achievement in basic science in junior secondary schools than the conventional method in vogue in the nation and It was recommended that the conventional method presently in use by basic science teachers should either be improved upon, modified or replaced with an activity- based teaching approach (as appropriate).*

Keywords: *instruction, stimulation, instructional stimulation, academic performance.*

Introduction

Science education is an essential instrument for national development. The impact of science and technology on the society cannot be overemphasized. Modern invention and discoveries have cumulatively helped to improve man's progress in health, happiness and productivity. Omiko (2017) cited Olagunju, Adesoji, Ireogbu and Ige (2013) that the relevance of science to national goals, aspirations and economy, dictates to large, the huge commitment and support which nations make and give to science and technological development.

According to Osuafor and Okoli (2013) that in this contemporary age of scientific and technological advancement, the need to keep pace with the global trend of development demands that people should be scientifically literate (Osuafor and Okoli, 2013). Without scientific literacy among a sizable proportion of the society, progress in achieving modernization will be difficult. Also, Christogonus, Okechukwu, Omebe and Martha (2014) asserted that knowledge in basic science is central and indispensable to the development of every nation. This is due to its crucial roles in the child's survival, adjustment and adaptation to his/her immediate and wider environments dominated by scientific activities.

Isa (2000) cited in Iwuji (2012) that at junior secondary school level; integrated science (now Basic Science) was introduced for the purpose of giving foundation skills and knowledge for subsequent science studies at the higher level. The acquisition of appropriate skills and the development of mental, physical and social abilities and competencies for the individual to live in and contribute to the development of the society in which he lives, has been a major concern of Basic Science. The subject views nature in a holistic approach and this makes it a discipline in its own right. The above definitions show that science is not just a collection of data and facts neither is it an assembly of sterile body of knowledge but that, it involves engaging in certain activities as well (Isa , 2000 cited in Iwuji, 2012).

Iwuji (2012) asserted that Integrated science (now Basic Science) was introduced to Nigerian secondary schools in 1972 at the junior secondary school level as a result of the outcome of Science Teachers Association of Nigeria (STAN) Committee set up to look into the three (3) sciences i.e. Biology, Chemistry and Physics. The program has been in existence for forty (40) years. Recently, there was a trend

from integrated science to Basic science following the Nigeria Educational Research and Development Councils (2007) decision to re-structure the Basic Education Programme to the 9-year Basic Education Programme in order to attain the Millennium Development Goals (MDGs) by 2015. It became imperative that the existing curricula for primary and JSS should be reviewed, restructured and realigned to fit a 9-year basic education programme and the upper basic education curriculum is for JSS 1-3 level. Basic Science concepts (content is almost the same except for introduction of some basic technological concepts) is generally geared towards technological development and appropriate strategy for the acquisition of relevant skills needed for meaningful learning of science concepts.

The development of Basic science and Technology as a subject area happened in Nigeria in the late 1960s, and teaching and learning have since been entrenched in schools (Opara and Etukudo, 2014).

According to Ukpai, Gabriel, Okechukwu and Ugama (2016) basic science is a basic subject that lays foundation for the take off of the sciences (biology, chemistry and physics) in the secondary classes. Basic Science is otherwise known as basic education in science which cuts across six (6) years of primary education and three (3) years of junior secondary education. According to National Policy on Education (2004), the specific goals of basic education shall be the same as the goals of the levels of education to which it applies (i.e. primary education and junior secondary education). Basic science is an introductory course to the study of sciences in senior secondary school. Basic science and technology is designed for pupils at the lower basic and middle levels of primary education.

Although the current emphasis has been on students' performance in sciences, it must be appreciated that students' achievement in any course is a function of instruction. Approaches to instruction therefore were considered a serious factor in science education especially with the current emphasis on competency based and sustainable science education for Africa. While also the prescription was not specifically tied to the simulated classroom in science teaching recent emphasis in virtual learning open an avenue for making relevant trials on simulation models.

Simulation means imitation of situation or process. For example, simulation of blood flowing through arteries or an electron revolving round the outer part of an atom. Simulation is otherwise known as 'the act of pretending or deception'.

Umoke and Nwafor (2014) asserted that with the development of the Keller's model, which is a Child Centered laboratory Model, and the empirical proofs of its efficacy, much attention in science instruction was geared towards the simulation approach. Skinner in 1954 invented a stimulus for the integrated approach. Skinner's basic argument for simulation was that the learning of any behaviour no matter how complex rested on the mastery of a sequence of less complex
component behaviours.

Coulter (2009) and Krulik (2010) cited in Umoke and Nwafor (2014) 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 (Coulter, 2009; Krulik, 2010). According to Krulik (2010) in 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 behavior by applying previously acquired skills or knowledge.

According to Abimbade (1999) cited in Awodun (2010), Simulation involves the use of model- a simplified version of reality which reduces the complexity of a real-life situation, taking from reality only those essential features of the learning objectives. Simulation can bring into the classroom, aspects of the world or universe that are too expensive, dangerous, difficult or too slow or too fast in occurrence to be experienced firsthand (Coulter, 2009). For example, there are simulation that can illustrate the human circulatory system along with its major arteries, veins and capillaries. Natural occurrences such as earthquakes, radioactivity, predators/prey relationships which occur too rapidly to be observed, can be illustrated through simulation. Simulation may, therefore, make learning more concrete and meaningful. Although simulation has been severally applied in physical sciences and medicine, its relevance in biology instruction is still being speculated.

Umoke and Nwafor (2014) asserted that simulations of one form or another have been used since the early 1900s as a method for training or retraining. The United States Defense Modeling and Simulation Coordination Office identifies three main types of simulation: live, virtual, and constructive. Live (live action) and virtual simulations are primarily used for training purposes, whereas a constructive simulation

is used to view or predict outcomes like war gaming or stock market behavior. Each of these types is based on some reality and is intended to provide the user with a pseudo-experience without the danger, expense, or complexity of real life.

According to Akinsola and Animasahun (2007) simulation – game instructional strategy might be an antidote. Randel, Morris, Wetzel and Whitehill (1992) are of the opinion that since many students enjoys playing games; it is worthwhile to investigate whether this play aspect could be combined with instruction to enhance learning. It is further stressed that the observation had led educators to explore the feasibility of using a game format to supplement or even replace the teaching of a variety of subjects.

Simulation is used with the aid of computer to simplify real life situation (simulation) and this will aid to manage the class, support reluctant learners, stimulate gifted children and ease administration. Although the efficacy of the simulation approach to science instruction is quite pronounced in literature, the practical impact of the instructional approach on students' mastery of units of instruction in biology is still in doubt. In the same vein, because simulations may be gender based (depending on stimulus utilized) it may be worth speculating that instructional simulation may have fascinating implications for male and females in basic science subject classroom.

Simulation employs selected aspects of a real-life situation. The usefulness of simulation and games in teaching cannot be undermined, mere teaching the students topic in the class may not be enough to achieve the desired objectives. Therefore, this study is intends to examine the effects of instructional simulation on students' academic performance in Basic Science in junior secondary school in Ekiti State, Nigeria.

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

1. There is no significant difference in the achievement mean scores of students in basic science before and after treatment
2. There is no significant difference in the achievement mean scores of male and female students in basic science in each of the experimental and control groups before and after the treatment.

Methodology

The research design adopted in the study was Pretest-Posttest Quasi- experimental. The sample for the study was 160 public junior Secondary two (JSS2) Basic science students (this sample was divided into the experimental and control groups in ratio 1: 1 i.e. 80 in each group), selected through the simple random sampling technique from four public junior secondary schools in Ikere Local government Area, Ekiti State., Nigeria.

The instrument used to collect relevant data from the subjects was Basic Science Achievement Test (BSAT) and the treatment package used for the study was tagged: Simulation Instructional Package (SIP). The reliability of the instrument was determined through the split-half method with the reliability coefficient of 0.82.

The administration of the instrument was in three stages: the pre-treatment stage (two weeks), the treatment stage (four weeks) and the post-treatment stage (two weeks). Eight weeks altogether were used for the whole study. The experimental group was treated with simulation instructional package (i.e. the students were taught using simulation instructional package) while, the control group were taught with the same concepts but through the conventional teaching approach.

Two null hypotheses were tested at 0.05 level of significance. The data collected were analysed using inferential statistics of t-test and Analysis of Covariance (ANCOVA).

Results and Discussion

Hypothesis 1

There is no significant difference in the achievement mean scores of students in basic science before and after treatment

Table 1: Summary table of Paired samples t-test analysis of students' achievement mean score in basic science before and after treatment

MEAN SCORE	N	$\bar{X}$	SD	df	t_{cal}	t_{tab}	Result
After Treatment	80	82.63	24.16				
Before Treatmer	80	54.33	12.88	158	9.25	1.65	*

P < 0.05 (Result Significant at 0.05 level). * = Significant , NS = Not Significant

As shown in table 1, the mean score of students achievement in basic science before and after treatment were statistically compared, a *t-value* (t_{cal} = 9.25 > t_{tab} = 1.65) at P < 0.05 alpha level for Pre-test achievement and Post-test achievement scores was obtained, which was significant at 0.05 level. This implies that there is a significant difference in the students' achievement in basic science before and after treatment. Consequently, the null hypothesis which states that there is no significant difference in the achievement mean scores of students in basic science before and after treatment was rejected.

Hypothesis 2

There is no significant difference in the achievement mean scores of male and female students in basic science in each of the experimental and control groups before and after the treatment.

Table 2: Summary of ANCOVA on the achievement mean scores of male and female students in basic science in each of the experimental and control groups before and after the treatment

Source of variation	SS	Df	Ms	F_{cal}	F_{tab}	P	Result
Corrected model	21830.831[a]	4	5432.738	80.74		0.000	
Covariate (pretest)	6947.021	1	7747.051	107.01	3.89	0.000	
Gender	6 .185	1	5.193	0 .18	3.89	0.788	NS
Group	17745.972	1	17845.972	221.23	3.89	0.000	*
Gender *Group	160.687	1	160.687	3.13	3.89	0.137	NS
Error	20100.548	155	71.728				
Corrected Total	32131.800	159					
Total	851562.000	160					

P > 0.05 (Result Not significant at 0.05 level), NS = Not Significant , and * = Significant

Table 2 showed that the computed *F-value* (F_{cal} = 0.18 < F_{tab} =3.89) with a *P-value* (P > 0.05 alpha level) obtained for students' gender was not significant. Hence, the achievement mean scores of male and female students in basic science in each of the experimental and control groups before and after the treatment were not significantly different. The table also revealed that the computed F-*value* (F_{cal} = 3.13 < F_{tab} =3.89) with a *P-value* (P > 0.05 alpha level) obtained for the interaction of gender and group was not significant as well. Thus, the null hypothesis 2 was not rejected. This implies that there was no significant interactions in the achievement mean scores of male and female students in each of the experimental and control groups. In other words, gender of students has no significant influence on either the effectiveness or otherwise of the approach of instruction applied in relation to their academic achievement.

Discussion

From the findings of this study, one could note that there is significant difference in the students' achievement in basic science before and after treatment in each of the groups. The implication of this result is that: conventional method of instruction is not potent enough to effect positive change in students' achievement in basic science, whereas, the simulation teaching approach expedite 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 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. The implication of this result is that gender was not a significant predictor of students' achievement in basic science.

Conclusion

This study centered on the effects of instructional simulation on the achievement of junior secondary school students in basic science.

Based on the findings of this study, it can be concluded that simulation activities teaching approach is more potent in stimulating students' achievement in basic science in secondary schools than the conventional method in vogue in the nation. It can also be concluded that the effect of teaching approach on junior secondary school basic science was also found not to vary with gender of students. This simply implies that performance of students taught using different teaching approaches is not in any manner affected by their gender.

Recommendations

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

1. Since the hitherto commonly used conventional method of instruction in formal schools had been empirically discovered in this study to be less potent and less effective than instructional simulation approach mode of teaching in improving junior secondary school students' academic achievement in basic science, the conventional method presently in use by basic science teachers should either be improved upon, modified or replaced with an activity- based teaching approach (as appropriate).
2. Basic science teacher should be encouraged to adopt simulation teaching approach in order to: demystify basic science in its entirety; simplify the perceived abstract nature of basic science-concepts for improved students' academic achievement in basic science for improved academic performance and subsequently create an environment where people would realize that basic science is neither an 'abstract' nor 'esoteric' subject that cannot be understood by diligent learners as many currently erroneously presume.
3. State and Federal Government should equip all schools with necessary facilities for the application of simulated instruction. This will include laboratories, computers and accessories.
4. State and Federal Governments should encourage and sponsor in-service training for science teachers on the application of simulation. Most importantly the government should beef up computer literacy programmes for both students and teachers because simulation utilizes computer programmes to a large extent.

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Every human being is the author of his own health or disease.
~ Sivanada