

EFFECT OF GROUP-BASED MASTERY LEARNING MODEL ON ACADEMIC ACHIEVEMENT OF STUDENTS IN BASIC SCIENCE

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Abstract

This study investigated the effect of group-based mastery learning model on academic achievement of students in Basic science in Nsukka Local Government Area of Enugu state. The design adopted for the study was quasi-experimental design; specifically, the non-equivalent control group design. Two research questions were raised and two hypotheses were formulated. The population of the study comprised all Junior Secondary Two (JSII) students in Nsukka Local Government area who are offering basic science. The sample size of the study comprised 72 basic science students drawn from two co-educational secondary schools. One class each was randomly assigned to experimental group while the other was the control group from both schools. Basic Science Achievement Test (BSAT) was used as the instrument for data collection. It was trial tested and analyzed using Kuder-Richardson formula20 (KR 20) and the coefficient obtained was 0.71. Data was collected and the research questions were answered using mean and standard deviation while analysis of covariance (ANCOVA) was used to test the hypothesis at 0.05 level of significance. The results showed that students taught using group-based mastery learning model achieved higher than those taught using lecture method. The result also revealed that female students had higher mean achievement scores than their male counterparts. Based on the findings of the study, it was recommended that Workshops, seminars and conferences should be conducted for basic science teachers on the use of group-based mastery learning model to enable them incorporate it effectively in their teaching.

Keywords: Basic science, Achievement, Group-based mastery learning model, Bloom's mastery learning model, Gender.

Introduction

Science has been and would continue to be of tremendous importance because of its ability to explain many natural occurrences and the central role it plays currently in the world's technological development. It helps in improving the quality of life of the individuals and the society at large. In Nigeria, sciences are taught in school subjects as Biology, Chemistry, and Physics in senior secondary schools, and as Basic science and Technology in Upper Basic Education (UBE) level. The development of Basic Science and Technology as a subject area occurred in Nigeria in the late 1960s. It is a broad field curriculum in which subject matter is integrated with the various science subject areas of Biology, Chemistry, Physics, Astronomy, Geology and Environmental Science, and synthesized to provide a wholistic and unified nature of science (Federal Republic of Nigeria, 2013). This holistic view is to eliminate the

general fear of the study of science as well as remove the restrictions imposed by the arbitrary subject boundaries of the separate sciences. It is expected that by teaching Basic Science to children at the UBE level, every Nigerian student would be given the basic knowledge and understanding of what science is all about and some of the innovations that are taking place around them. This assertion blends with the objectives of science teaching at the Upper Basic level of Education which is to produce individuals who will be able to live effectively in the modern age of science and technology and contribute to the development of the nation (FRN, 2013).

Basic Science enables students to understand science concepts, principles, theories and laws which are further elaborated in the core sciences (Ekundayo, 2012). Therefore, there is a need for effective science teaching and learning in our schools as sure means of achieving the needed technological breakthrough in Nigeria. This can only be achieved by a meaningful means of impartation of knowledge through good systems of instruction and teaching techniques. There are systems of instruction for imparting knowledge into learners which include differentiated instruction, personalized system of instruction or individual tutoring, group instruction among others (Rouhani, 2017). But the prevailing Educational system was designed around group-based, teacher-paced approaches to classroom instruction. This system allows schools to accommodate a number of students and a teacher is mandated to pace a classroom of students through curricular material as a group through the class lecture method. Students whose learning does not conform to the pace of instruction struggle to keep up as the disparity between their understanding and that of their better-performing peers increases. Students in the same classroom, receiving the same instruction from the same teacher, reach learning outcomes differently (Rouhani, 2017). But this structure has its weakness; it gave rise to achievement differences which has constantly affected students' achievement in basic science.

Academic achievement is the extent to which a student, teacher or institution has attained their short or long-term educational goals. According to Aniakwu (2013), academic achievement is the accomplishment of educational goal, educational outcome of students or the extent to which a teacher or instructor has achieved the stated educational objectives. The report of the chief examiner of Basic Education Certificate Examination (BECE) 2020 showed that basic science students' achievement scores had no significant improvement with the previous year because students' achievement was just a little above average. According to Balaraba (2016), most of these challenges associated with the achievement of Basic Science students have been attributed to inadequate exposure of students to scientific activities and experiments, failure to use effective methods of teaching science subjects, large classes, little time allocation to class work, inadequate preparation and inability to comprehend questions on the part of the learners. In an effort to solve this achievement gap, energy is directed towards determining teaching models or techniques that are best fitted into the existing structure of education and can produce achievements similar to individualized instruction so that the wide achievement differences in students' achievement score can be reduced to the bare minimum. This need gave rise to the investigation of the feasibility of group-based mastery learning models whose idea is that all students can learn and achieve high level of mastery given the appropriate learning conditions and which will still maintain the structure of educational system.

Mastery Learning according to Lynn, Douglas and Gerald (2009), is an instructional process that provides students with multiple opportunities to demonstrate content mastery. Mastery

learning is an instructional model based on the principle that all students can learn a set of reasonable objectives with appropriate instruction and sufficient time to learn. It is an alternative method of teaching and learning that involves the student reaching a level of predetermined mastery on units of instruction before being allowed to progress to the next unit. Mastery Learning puts the techniques of tutoring and individualized instruction into a group learning situation and brings the learning strategies of successful students to nearly all the students of a given group. The theories of mastery learning resulted in a radical shift in responsibility for teachers; the blame for a student's failure rests with the instruction not a lack of ability on the part of the student. In this type of learning environment, the challenge becomes providing enough time and employing instructional strategies so that all students can achieve the same level of learning (Levine, 1985). Initial instruction is presented to engage all learners. If a student does not achieve mastery on the test, they are given additional instruction, and the information reviewed and then tested again. This is repeated until the learner achieves mastery, then they move on to the next stage. Mastery learning methods suggest that the focus of instruction should be the time required for different students to learn the same material and achieve the same level of mastery which is in contrast with classic models of teaching, that focus more on differences in students' ability and where all students are given approximately the same amount of time to learn and the same set of instructions. There are two models of Mastery Learning; Bloom's Model of Mastery Learning and Keller's approach to Mastery Learning which is also known as Personalized System of Instruction (PSI). For the purpose of this study, Bloom's model of mastery learning will be used.

Bloom's mastery learning model is essentially group-based. The model is also known as learning for mastery (LFM). Carroll (1967) developed a model which actually suggests that, if each student was allowed the time they needed to learn to some level, then he could be expected to attain that level. Later, Bloom (1968) used Carroll's conceptual model to create his own working model of Mastery Learning. In this model, one can provide opportunity in the classroom that all students can achieve high level of academic achievement and their differences in learning can be minimized. The students who did not show mastery in the formative test in specified level (80% to 90% of correct performance) are taught again and receive final exam until all students pass the exam, showing that they have mastery on lesson unit.

Feedback, corrective and enrichment procedures are crucial elements of mastery learning, for it is through these procedures that mastery learning differentiates and individualizes instruction. In every unit taught, students who need extended time and opportunity to remedy learning problems are offered these through correctives. Those students who learn quickly and for whom the initial instruction was highly appropriate are provided with opportunities to extend their learning through enrichment. As a result, all students are provided with more favorable learning conditions and more appropriate, higher quality instruction (Bloom, 1976). In view of this, this study intends to find out if this model will be appropriate for male and female students.

Gender imbalance which is a conceived structural relationship of inequality between males and females is manifested in our educational system. Many research works have been carried out to determine the relationship between gender and students' performance. Kolawole (2007) found out that male students performed better than female students in the cognitive, affective

and psychomotor skill achievements, showing that gender has a significant influence on the achievement of students. Ingels and Dalton (2008), revealed that females tend to perform better than males in areas of standardized science assessments that address the human application of science such as life science. In contrary, Oludipe & Oludipe, (2018) provided reports that there are no distinguishing differences in the cognitive, affective and psychomotor skill achievements of students in respect to gender. These reports show that there is no agreement on the effect of gender on the academic achievement of students. Thus, this study intends to investigate the effect of group-based mastery learning on male and female students' achievement in Basic Science.

Purpose of the Study

The purpose of this study is to determine the effectiveness of group-based mastery learning model on students' achievement in basic science at the junior secondary school level. Specifically, the study is aimed at determining the;

1. Effects of group-based mastery learning model and the lecture method on students' achievement in Basic science.
2. Influence of gender on mean achievement scores of students in basic science.

Research Questions

The following research questions were developed to give direction to the study:

1. What are the effects of group-based mastery learning model and the lecture method of teaching on students' mean achievement score in basic science?
2. What is the influence of gender on students' mean achievement score in Basic science?

Hypotheses

The following null hypotheses were formulated and will be tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of basic science students taught using group-based mastery learning model and those taught using the lecture method
2. There is no significant influence of gender on the mean achievement scores of male and female students in basic science.

Methods

A quasi-experimental design; specifically, the non-equivalent control group design was used in the study. The study was restricted to public Junior Secondary School Two (JSSII) students in Nsukka Local Government Area of Enugu State. The population is 2,830 (1337 males and 1493 females) basic science students from the 31 public schools in the Local Government Area. The sample size of this study is 72 junior secondary school students, made up of 33 males and 39 females selected from two co-educational secondary schools. The instrument that was used for the collection of data is Basic Science Achievement Tests (BSAT) which was developed by the researchers and consisted of 30 items of multiple-choice objective test with four response options; A, B, C and D scored one mark each. The BSAT was subjected to validation and was also trial-tested. An internal consistency reliability index of 0.71 was obtained using Kuder-Richardson formula 20 (K-R20).

Experimental Procedure

The researchers trained the JSSII basic science teachers, who were the research assistants. The BSAT was administered to the students before the commencement of the experiment as Pre-test. The research assistants organized and taught the students in the experimental group using the group-based mastery model and those in the control group using lecture method. At the end of four weeks, the BSAT was administered to the two groups as Post-test and the data was collected for analysis. The data collected was analysed using mean and standard deviation in answering the research questions, Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05% level of significance.

Results

Research Question one: What are the effects of group-based mastery learning model and lecture method of teaching on students' mean achievement score in basic science?

Table 1: Mean ($\bar{X}$) and standard deviation (SD) on the achievement scores of students taught using group-based mastery learning model and lecture method.

Groups	N	Pre-test		Post-test		Mean gain score
		$\bar{X}^1$	SD ₁	$\bar{X}^2$	SD ₂	
Group-based method	31	10.70	4.23	21.58	3.00	10.88
Lecture method	41	10.56	4.67	12.07	5.26	1.51
Difference in mean		0.14		9.51		

The above table shows that students taught using group-based mastery learning and those taught using lecture method had a post-test mean achievement score of 21.58 and 12.07 with standard deviation of 3.0 and 5.26 respectively. Also, their mean gain scores were 10.88 and 1.51 and this is an indication that the group-based mastery learning achieved higher than the lecture method in the basic science.

Research Question two: What is the influence of gender on student's mean achievement score in basic science when taught using group-based mastery learning model and lecture method?

Table 2: Mean ($\bar{X}$) and standard Deviation (SD) of the influence of gender on students' mean achievement scores in basic science.

Gender	N	Pre-test		Post-test		Mean gain score
		$\bar{X}^1$	SD ₁	$\bar{X}^2$	SD ₂	
Male	33	10.00	3.77	11.15	4.96	1.15
Female	39	14.69	7.56	17.41	5.16	2.72
Difference in mean		4.69		6.26		

The table reveals that the mean gain score of 1.15 and 2.72 with a post-test score of 11.15 and 17.41 for the male and female students were obtained respectively. The result therefore, shows that the female students achieved better than the male students in basic science.

Hypotheses

The following null hypotheses were formulated to give direction to the study:

H0₁: there is no significant difference in the achievement of students taught using group-based mastery learning model and those taught using the lecture method

Table 3

Tests of Between-Subjects Effects					
Dependent Variable: lecture method					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	208.325 ^a	19	10.964	40.374	.008
Intercept	5067.929	1	5067.929	172.642	.000
Group-based method	208.325	19	10.964	40.374	.008
Error	1232.917	42	29.355		
Total	8193.000	62			
Corrected Total	1441.242	61			

a. R Squared = .145 (Adjusted R Squared = -.242)

The data in the table above showed that there was a significant effect on students' achievement in basic science $F(40.374)$, $P < .008$. The null hypothesis therefore was rejected, indicating that there was a significant difference in the mean achievement score of students.

H0₂: there is no significant influence of gender on the achievement of male and female students in basic science when taught using group-based mastery learning and lecture method

Table 4

Tests of Between-Subjects Effects					
Dependent Variable: pre-test group base method					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	4.589 ^a	1	4.589	22.250	.041
Intercept	3497.750	1	3497.750	190.739	.000
Gender group-based	4.589	1	4.589	22.250	.041
Error	531.798	29	18.338		
Total	4092.000	31			
Corrected Total	536.387	30			

a. R Squared = .009 (Adjusted R Squared = -.026)

Data in the table above showed that there was a significant influence of gender on the achievement of students in basic science $F(22.250), P < 0.041$. The null hypotheses therefore was rejected, indicating that there was a significant difference in the mean achievement scores of male and female students in basic science.

Summary of the Results

The major findings from this study are presented below:

1. Basic science students who were taught using the group-based mastery learning significantly achieved higher than those who were taught using the lecture method.
2. Female students achieved better than male students in basic science achievement test.

Discussion of Results

The discussion of the results of this study is based on the research questions and hypotheses of this study.

Effects of group-based mastery learning model and the lecture method on students' achievement in Basic science

The result of the study showed that the use of group-based mastery learning model significantly facilitated students' achievement in basic science than those taught with the lecture method. This could be as a result of the extra time given to the students to fully master the contents and also because of the breaking down of learning materials into learnable units for the groups to comprehend. The model offers re-teaching and re-testing and sure that students master a unit before advancing to the next one. This enabled them to understand the concepts and hence performed better than their counterparts who were taught with the lecture method. The result is in line with Nirmala (2015), who conducted a study on the Effect of Mastery Learning Strategy on Achievement of Students in Biology. The results showed that the performance of students who were exposed to mastery learning strategy was better than the performance of students who were taught through conventional method of teaching. And it agrees with Iserameiy and Ibeneme (2018), in their research on the Effect of Mastery Learning Strategy on Junior Secondary School Students' Academic Achievement in Basic Technology in Edo State, Nigeria. The result indicates that MLS is an effective instructional strategy that significantly enhances students' academic achievement. Therefore, this study showed that group-based Mastery learning model helps in enhancing students' achievement in basic science

Influence of Gender on Students' Achievement in Basic science when taught using Group-based mastery learning model and lecture method.

There is significant influence of gender on the achievement of male and female students in basic science when taught using group-based mastery learning and lecture method. Female students achieved better than male students in both pre-test and posttest in basic science. This could be as a result of females exercising more socializing skills which enabled them to explore their environment and identify the different features of each habitat more than the males which helped them to perform more than the males. This agrees with the study carried out by Filgoea and Sabeba (2017) on the effect of gender on senior secondary school students' academic achievement in geography showed that female students exposed to learning geography through mastery strategy performed better than their male counterparts. Also, the study carried out by Godpower-Echie & Ihenko (2017), on the influence of Gender on Interest

and Academic Achievement of Students in Integrated Science in Obio Akpor Local Government Area of Rivers State, showed that gender has a significant influence on the interest but does not have significant influence on achievement of Integrated Science students. This result is however different from the finding of Oludipe, (2012), in his study on the gender Difference in Nigerian Junior Secondary Students' Academic Achievement in Basic Science. The Findings of the study revealed that there was no significant difference in academic achievement of male and female students at the pretest, posttest, and delayed posttest levels. Therefore, this study showed that there is significant influence of gender on the achievement of male and female students in basic science when taught using group-based mastery learning and lecture method.

Conclusion

From the results of the study on the effect of group-based mastery learning model on the achievement of students in basic science, it was discovered that students who were taught basic science using group-based mastery learning model performed better than their counterpart who were taught using lecture method. Also, female students achieved significantly better than the male students in basic science, showing that gender has a significant influence on the achievement of students in basic science. Hence, this study showed that group-based mastery learning model enhances students' achievement in basic science.

Educational Implications

The findings from this study have some educational implications which are discussed below: Theoretically, the findings of the study helped in validating Carroll's theory of school learning, which states that all children can learn provided that they are given adequate time for mastery. The current useful and reliable information provided by the findings will enable curriculum experts to improve the Basic science curriculum by adopting the group-based mastery learning, training and encouraging classroom teachers to apply it in their teaching. With these findings, classroom teachers are provided with dependable information on the effectiveness of group-based mastery learning. Therefore, they are better equipped to get their students to acquire higher level of achievement in basic science concepts and skills and deal with the problem of low aptitude and reduce achievement gaps for students.

Recommendations

Based on the findings and educational implications of this study, the following recommendations were made.

1. Workshops, seminars and conferences should be conducted for basic science teachers on the use of group-based mastery learning model to enable them incorporate it effectively in their teaching.
2. Educational administrators including heads of schools should constantly monitor their teachers to determine how well they are using the method and to ensure that they do not only engage in the lecture method of teaching.

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