

Effect of Mastery Learning Approach on Secondary School Students Achievement in Chemistry in Rivers State Nigeria

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Abstract

The study examined the effect of mastery learning on secondary school achievement in chemistry. It adopted a quasi experimental design. A fifty (50) item multiple choice option of chemistry Achievement test constructed from chemical strometer, mole concept, electrolysis, acid, base and salt) was used for the collection of protest posttest scores. A 2x2x2 factorial design was used. The analysis of covariance ANCOVA was used in testing significance and validity of different variables used in the hypothesis. The Statistical Package for the Social Sciences (SPSDS) was used for data analysis, to enhance accuracy of the result obtained. The results show that the mean difference in academic achievement between the two teaching approaches was in favour of the experimental group was very minimal ($F_{(1,157)}=83,378, p=0.000$), It also indicates that the mean difference in achievement between the male and female between the urban and rural students of the experimental group is very minimal ($F_{(1, 77)}=1.233, p=2.70$). It revered that the mean difference in achievement between the male and the female urban students of the experimental group was very minimal ($F_{(1, 37)}=.871, p=357$). It indicates that the mean difference in academic achievement between the male and the female rural students of the experimental group is very minimal $F_{1,} = 1.667, p = .205$). The experimental group (mastery learning) performed significantly better than the control group (conventional teaching method); government should motivate teachers by ensuring good conditions of service, considering that mastery learning strategy demand absolute dedication on the part of teachers, the schools should allow more flexibility in the time assigned to teach a unit of subject in order to attain mastery.

Key Words: Mastery Learning, Conventional Teaching Method, Academic, Achievement School Location, Gender.

Introduction

Nigerian secondary school students' performance in science subjects has been poor and unimpressive over the years (Aghadinuno, 1987, Njoku 1995). Njokus (1995) analysis of students' performance in the sciences at SSCE / O'level revealed that between 1980 and 1991, the annual average pass rate at credit level (grades 1-6) in chemistry was 15.41% while the absolute failure rate (grade 9) was 61.82%. Akinleye (1987) observed that students' poor performance in the practical aspect of chemistry examination in Senior School Certificate examination (SSCE) contributes to the high failure rate of students in chemistry.

Hill (1988) described chemistry as a major factor in the science curricula in schools, colleges, polytechnics and universities chemistry is so inclusive that it serves as a pre-requisite to the study of all science - based professional curses like medicine, pharmacy, agriculture and engineering. Thus, a very good understanding of chemistry at the senior secondary level is an essential background for good scientific advancement. Industries that have direct and indirect impact on the lives of men and their survival depend a lot on Chemistry. Chemistry being a major feature of the science curriculum in schools colleges and polytechnics as well as the universities, is very important in modern society like Nigeria

Despite the importance of chemistry to mankind and the efforts of researchers to improve on its teaching and learning, the achievement of students in the subject remains low in Nigeria. Among the factors that have been identified outcomes in chemistry are, poor methods of instruction (Osuior. 1999) teacher's attitude (Aghadiuno, 1992), laboratory in-adequacy (Okegbile. 1996 Raimi 1998; Bajah, 1999 and Adeyegbe, 2005), and poor science background (Oshokoya, 1998 and Adesoji, 1999).

Inadequate instructional strategies as identified by Unachukwu (1900), Okebnkola (1990), Enjayeju and Enjayeju (1994), Obemeata (1990), Okebukola (1990), To this end, it was found that the lecture method is the most commonly adopted method of instruction in our schools (Taiwo, 1975; Bnerjee, 1997). Abdullahi (1982) observed that eighty percent of the scientific information or principles that students receive form their teachers come through the lecture method. But Abdullahi (1982), Aghenta (1982), and Ajewole (1990) have described a lot of disadvantages to this method

The concept of mastery learning can be attributed to the behaviorism principles of operant conditioning. According to operant conditioning theory, learning occurs when an association is formed between a stimulus and response (Skinner, 1984). In line with the behavior theory, mastery learning focuses on overt behaviors that can be observed and measured (Baum, 2005). The material that will be taught to mastery is broken down into small discrete lessons that follow a logical progression. In order to demonstrate mastery over each lesson, students must be able to overtly show evidence of understanding of the material before moving to the next lesson (Anderson, 2000).

In a mastery learning environment, the teacher directs a variety of group-based instructional techniques, with frequent and specific feedback by using diagnostic, formative tests, as well as regularly correcting mistakes students make along their learning path. Assessment in the mastery learning classroom is not used as a measure of accountability but rather as a source of evidence to guide future instruction. A teacher using the mastery approach will use the evidence generated from his or her assessment to modify activities to best serve each student. Teachers evaluate students with criterion-referenced tests rather than norm-referenced tests. In this sense, students are not competing against each other, but rather competing against themselves in order to achieve a personal best.

In general, mastery learning programs have been shown to lead to higher achievement in all students as compared to more traditional forms of teaching (Anderson, 2000; Gusky & Gates, 1986). Despite the empirical evidence, many mastery programs in schools have been replaced by more traditional forms of instruction due to the level of commitment required by the teacher and the difficulty in managing the classroom when each student is following an individual course of learning (Anderson, 2000; Grittner, 1975). Despite the conclusive evidence that an appropriately instituted mastery approach to instruction yields improvement in student achievement, there is a strong movement against it. Critics of mastery learning often point to time constraints as a flaw in the approach. The mastery learning model has been found to be beneficial in many settings. It allows struggling students an opportunity to master critical concepts before new content is introduced. At the same time, it provides a challenge for high achieving students. This style of education allows gifted students to accelerate through the program and move on to either the next level (year) or to engage in extension studies which will broaden their understanding of the subject. The model also allows for an individual learning pace. In addition, feedback that is given during this process is helpful for the student. This model stands for the fact that every learner can learn if given the time and the right learning environment.

Mastery Learning is a model where students are expected to master a learning objective or goal, before they can move on to the next goal. This is a model that was first described in the 1960's and has been proven effective by many researchers.

Research Hypotheses

To achieve the objectives of the study, the following hypotheses were tested:

- H₀₁:** There is no significant difference between achievement of students taught with the Mastery Learning Approach (MLA) and those taught using the Conventional Teaching Method (CTM) in Chemistry.
- Ho2** There is no significant difference between urban school students' taught with mastery learning and those in rural schools over academic achievement in Chemistry.
- Ho3** There is no significant difference in the academic achievement between the male and the female students in urban schools taught with mastery learning in Chemistry
- Ho₄: There is no significant difference in the academic achievement between the male and the female students in rural schools taught with mastery learning in Chemistry.

Methodology

Research Design

The design of this study was quasi – experimental

Population

The target population comprised all the Senior Secondary School Two (SS II) students in Rivers State. The accessible population involved all Senior Secondary School (SSII) students in Rivers State educational Authorities State. The public schools in Rivers State educational authority is made up of two single-sex schools for only boys and girls respectively; while in Port Harcourt LGA educational authority, there are two single-sex schools for boys and girls each respectively making a total of eight (8) /secondary schools

The Sample and Sampling Techniques

A sample of 160 students was used for the study. Random sampling techniques were used to select two male and female schools each from the urban (Port Harcourt) and rural (Okrika) areas in Rivers state. In the

selected urban LGA for instance, one of the male and female schools was used as the experimental (MLA) group while the other was used as the control (lecture) group. This same classification was repeated in the rural schools. Only twenty 20 (boys and girls) students offering geography were selected in each of the eight (8) classes included in the study, to make a total of one hundred and sixty (160) students.

Instrumentation

The instrument used in this study was the Chemistry Achievement Test (CAT). The CAT was used to measure the academic achievement of the students. The CAT consisted of fifty 50 items which included multiple choice options to be marked over 100. The CAT was based on physical Chemistry (Mole concepts, electrolysis, Acid base and salt). The total number of items for each topic is ten (10), the process objectives was based on the relative importance and the time spent in teaching the topics guided the decision on the design of CAT.

Chemistry curriculum

Level: senior secondary II (SSII)

Results and discussion

H₀₁: There is no significant difference between academic achievement of students taught with the Mastery Learning Approach (MLA) and those taught using the Conventional Teaching Method (CTM) in Chemistry.

Table 4.1: Post test mean scores of the experimental and control groups.

Method	N	Mean	SD
Mastery Learning Strategies	80	61.6000	5.94830
Conventional teaching method	80	54.3750	6.21223
Total	160	57.9875	7.06305

Table 4.1b. Summary of analysis of covariance (ANCOVA) for the significance of difference in the cognitive achievement between the experiment and control groups.

Source of variation	Sum of squares	Df	Mean square	F	Sig.
Corrected Model	5569.160	2	2784.580	185.025	.000*
Intercept	3050.990	1	3050.990	202.727	.000*
Pretest	3481.135	1	3481.135	231.308	.000*
Method	1254.817	1	1254.817	83.378	.000*
Error	2362.815	157	15.050		
Total	545940.00	160			
Corrected Total	7931.975	159			

Decision rule if $p < .05$ rejected H_0 * = Significant, $p < .05$

Table 4.1 b shows the summary of Analysis of Covariance (ANCOVA) for the significance of difference in the cognitive achievement between the experimental and control groups. Furthermore, the result shows that there is a significant difference between achievement of students taught with the Mastery Learning Approach (MLA) and those taught using Conventional Teaching Method (CTM) in Chemistry ($F_{1, 157} = 83.378$, $p = 0.000$). The null hypothesis of non significant difference was rejected. The result as shown in table 4.1a indicated that the mean difference in achievement between the two teaching approaches was in favour of the experimental group.

H₀₂: There is no significant difference between urban school students' taught with mastery learning and those in rural schools over academic achievement in Chemistry

Table 4.2a: Mean posttest scores of the rural and urban students of the experimental group.

Location	Mean	Sd	N
Urban	61.4500	6.50030	40
Rural	61.7500	5.41958	40
Total	61.6000	5.94830	80

Table 4.2b: Summary of Analysis of Covariance (ANCOVA) for the significance difference in the cognitive achievement between the urban and rural students experimental group

Source of variation	Sum of squares	Df	Mean square	F	Sig.
Corrected Model	1814.365	2	907.183	71.218	.000*
Intercept	1375.493	1	1375.493	107.982	.000*
Pretest	1812.565	1	1812.565	142.295	.000*
Method	15.704	1	15.704	1.233	.270
Error	980.835	77	12.738		
Total	306360.000	80			
Corrected Total	2795.200	79			

Decision rule: if $p < .05$ reject H_0 . Else retain H_0 .

Source: field survey (2012)

Table 4.2b shows the summary of Analysis of Covariance (ANCOVA) for the significance of difference in the cognitive achievement between the urban and rural students of the experimental group. Furthermore, the result shows that there is no significant difference between urban school students' taught with mastery learning and those in rural schools over academic achievement in Chemistry ($F_{1, 77} = 1.233$, $p = .270$). The null hypothesis of no significant difference was retained. The result as shown in table 4.2a indicated that the mean difference in achievement between the urban and rural students of the experimental group was very minimal.

H01: There is no significant difference in the academic achievement between the male and the female students in urban schools taught with mastery learning in Chemistry.

Table 4.3a: Mean posttest scores of the male and the female students in the urban schools of the experimental group

Gender	Mean	Sd	N
Male	61.9000	7.00301	20
Female	61.0000	6.10436	20
Total	61.4500	6.50030	40

Table 4.3b: Summary of Analysis of Covariance (ANCOVA) for the significance of difference in the cognitive achievement between the male and the female students in the urban schools of the experimental group

Source of variation	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1194.866	2	597.433	48.793	.000
Intercept	1005.801	1	1005.801	82.145	.000
Pretest	1186.766	1	1186.766	96.925	.000
Gender	10.668	1	10.668	.871	.357
Error	453.034	37	12.244		
Total	152692.000	40			
Corrected Total	1647.900	39			

The table 4.3b shows the summary of Analysis of Covariance (ANCOVA) for the significance of difference in the cognitive achievement between the male and the female students in the urban schools of the experimental group. Furthermore, the result shows that there is no significant difference in the academic achievement between the male and the female students in the urban schools taught with mastery learning in Geography ($F_{1, 37} = .871$, $p = .357$). The null hypothesis of non significant difference was retained. The result as shown in table 4.3a indicated that the mean difference in achievement between the male and the female urban students of the experimental group was very minimal.

H_{04} : There is no significant difference in the academic achievement between the male and the female students in rural schools taught with mastery learning in Chemistry

Table 4.4a: Mean posttest scores of the male and the female students in the rural schools of the experimental group.

Gender	Mean	SD	N
Male	63.2000	4.95878	20
Female	60.3000	5.59229	20
Total	61.7500	5.41958	40

Table 4.4b: Summary of Analysis of Covariance (ANCOVA) for the significance of difference in the cognitive achievement between the male and the female students in the rural schools of the experimental group.

Source of variation	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	657.381	2	328.691	24.915	.000
Intercept	357.985	1	357.985	27.136	.000
Pretest	573.281	1	573.281	43.455	.000
Gender	21.992	1	21.992	1.667	.205
Error	488.119	37	13.192		
Total	153668.000	40			
Corrected Total	1145.500	39			

Decision rule: if $p < .$ Reject H_0 else retain H_0

Source: field survey (2012)

Table 4.4b shows the summary of Analysis of Covariance (ANCOVA) for the significance of difference in the cognitive achievement between the male and the female students in the rural schools of the experimental group. Furthermore, the result shows that there is no significant difference in the academic achievement between the male and the female students in rural schools taught with mastery learning in Chemistry ($F_{1,37}=1.667, p=.205$). The null hypothesis of non significant difference was retained. The result as shown in table 4.4a indicated that the mean difference in achievement between the male and the female rural students of the experimental group was very minimal.

Discussion of Findings

The purpose of the study was to determine the effect of mastery learning strategy on secondary school academic achievement in Chemistry in Rivers State.

There is a significant difference between academic achievements of students taught with the Mastery Learning Approach (MLA) and those taught using the Conventional Teaching Method (CTM) in Chemistry ($F_{1,157}=83,378, p=0.000$). The null hypothesis of non-significant difference was rejected. It indicates that the mean difference in academic achievements between the two teaching approaches was in favour of the experimental group (mastery learning approach). The finding synchronizes with the earlier works of Guskey and Gates (1986) which conducted a meta-analysis on the effect of mastery learning on achievement and retention. The findings show that students in mastery learning programs at all levels showed increased gains in achievement over those in traditional instruction program. There is no significant difference between urban school students taught with mastery learning and those in rural schools over academic achievement in Chemistry ($F_{1,77}=1.233, p=.270$). The null hypothesis of non-significant difference was retained. The result indicates that the mean difference in academic achievement between the urban and rural students of the experimental group was very minimal. The finding is consistent with earlier study of John and David (1990) which examined a model for investigating school location and variables which influences students' academic achievements, using structural model. The findings shows that school location (urban or rural) have minimal influence on academic achievement. There is no significant difference in the academic achievement between the male and the female students in urban schools taught with mastery learning in Chemistry ($F_{1,37}=.871, p = .357$). The null hypothesis of non significant difference was retained. The result indicates that the mean difference in

achievement between the male and the female urban students of the experimental group was very minimal. The finding synchronizes with the earlier works of Patrician and Johnson (2008) study on the effect of mastery learning approach on gender on students' achievement in Physics. The result of the study shows that mastery learning resulted in higher achievement but gender has no significant influence on their achievements.

There is no significant difference in the academic achievement between the male and the female students in rural schools taught with mastery learning in Chemistry FI, $37=1.667$, $p=.205$). The null hypothesis of non-significant difference 'was retained. The result indicates that the mean difference in academic achievement between the male and the female rural students of the experimental group was very minimal. The finding is consistent with the earlier work of Wachanga (2011) which investigated the impact of teaching method on gender in secondary schools students' academic achievement. The result shows that gender difference was of no significant impact on academic achievement of students

Conclusion

The results of the study have shown that there is a significant difference between academic achievement of students taught with the Mastery Learning strategy (MLA) and those taught using the Conventional Teaching Method (CTM) in Geography that the mean difference in academic achievement between the two teaching approaches was in favour of the mastery learning approach. The result 'also shows that there is no significant difference between urban school students' taught with mastery learning and those in rural schools over academic achievement in Chemistry, that the mean difference in academic achievement between the urban and rural students of the mastery learning group was very minimal. The result shows that there is no significant difference in the academic achievement between the male and the female students in urban schools taught with mastery learning in Chemistry, that the mean difference in achievement between the male and the female urban students of the mastery learning group was very minimal. The result also shows that there is no significant difference in the academic achievement between the male and the female students in rural schools taught with mastery learning in Chemistry, it indicates that the mean difference in academic achievement between the male and the female rural students of the mastery learning group was very minimal.

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