

Effect of Mastery Learning Strategy on Students' Achievement in Chemistry Secondary Schools in Akwa Ibom North East Senatorial District

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Abstract: The study determined the effects of mastery learning strategy on academic achievement of secondary schools students in Chemistry in AkwaIbom North East Senatorial district. Three specific purposes and their corresponding research questions and hypotheses were formulated to guide the study. The study used the quasi-experimental, pre-test, post-test research design. The population of the study comprised all the 2,536 SS3 Chemistry students in all the 75 public secondary schools in AkwaIbom North East Senatorial district in the 2021/22 academic session. The sample consisted of 100students (62 males and 38 females) selected purposively from two intact classes in two co-educational secondary schools in the study area. A 25-item Chemistry Achievement Test (CAT) which was used for data collection as pre-test and post-test. The mastery learning lesson plans constituted the treatment that was given to the experimental group while the control group were taught with the conventional lesson plans for three weeks. The instruments were face validated by three lecturers from the Faculty of Education, Abia State University, Uturu. The reliability of the Chemistry Achievement Test obtained through test-retest method was 0.74. The data collected was analysed using mean and standard deviation for answering the research questions while the null hypotheses were tested using Analysis of Covariance (ANCOVA).The findings revealed that there is significant difference in students' achievement in Chemistry when taught using Mastery Learning and lecture method in favour of those taught with master learning strategy. Also, there is significant difference in students' achievement in Chemistry based on their gender in favour of the male students. Moreover, there is significant interaction effect of teaching method and gender on students achievement in chemistry when taught using Mastery Learning and lecture methods. It is recommended, among others, that Chemistry teachers in AkwaIbom state secondary schools should henceforth adopt the mastery learning strategy in teaching important topics in Chemistry while the conventional teaching methods should be de-emphasized.

Keywords: Mastery learning, teaching method, academic achievement, Chemistry, gender

Introduction

Chemistry is one of the most important science subjects in the secondary school curriculum. Chemistry is defined as that branch of science which is concerned with the study of matter as it relates to energy as well as the study of laws that determine the structure of the universe with reference to the matter and energy in the universe (Muhammad, 2020). It is a physical science subject that is concerned with the fundamental ideas about nature and attempts to establish relationships between different quantities as precise as possible. The importance of Chemistry in Nigeria is buttressed by the fact that industries that have direct and indirect impact on human lives and their survival depend a lot on Chemistry. As a major component in the science curricula in schools, colleges, polytechnics and universities, Chemistry is very important that it serves as a pre-requisite to the study of all science - based professional courses in Nigerian tertiary institutions. A credit pass in Chemistry is required at the senior secondary school certificate examination for admission into science, and technology-related professional courses in Nigerian tertiary institutions such as medicine and surgery, dentistry, nursing, pharmacy, forestry, fisheries, agricultural sciences and all branches of engineering. Thus, a very good understanding of chemistry at the senior secondary level is an essential background for good scientific advancement. This underscores the need for the use of appropriate teaching methods in the teaching of chemistry.

Teaching methods refer to the various processes and strategies adopted and used by teachers to present skills, knowledge and appreciations to the learners in and outside the classroom to facilitate their learning of the curriculum content. There are many teaching methods which can be applied in science and technology subjects.

These include, among several others, the lecture method, project method, field trip/work visit, discussion and demonstration methods. One of the teaching methods that is very relevant to this study is mastery learning.

Mastery learning is an instructional approach where students need to demonstrate a deep level of understanding of a topic or unit before progressing into another topic or unit. According to Oginni, Akinola, Fadiji and Amole (2021), mastery learning strategy was developed by Benjamin S. Bloom, and the method consist of different steps which include distribution of content into parts, formulation of objectives related to each subdivision, organization of teaching for realizing objectives of each division, administering the formative test to evaluate the mastery level and diagnosing the knotty areas, giving remedial instructions to remove the ambiguities and finally, attainment of mastery level by every student.

Toheed& Ali (2019) pointed out that Mastery Learning emphasizes on the achievement of instructional objectives in each learning unit by all learners. The teacher first defines the acceptable mastery level for a particular task and then organizes a variety of individual or group-based instructional techniques to fulfil the requirements of all students. Formative assessment with regular feedback and corrective assignments are used to ensure the achievement of learning objectives. Formative assessments are used to diagnose the weak areas and to improve the instructional process rather than to measure achievement. At the end of each unit, criterion referenced tests are used for the evaluation of students' performance.

There are two majormodels or approaches of mastery learning namely individualized model and group-based model (Oginni, Akinola, Fadiji and Amole, 2021). In the Individualized model also known as the Keller model or personalized system of instruction, students are attended to individually and each student works through a series of self- paced modules and learns independently. This approach uses the system of reading and studying prepared study guides. Proctors are provided to give immediate feedback to the students and to assist them in their areas of difficulty. The study guide may take different forms from print-based, to computer-based and internet-based instruction. The Group-Based model is otherwise known as Blooms' model of mastery learning. The procedure for both models are basically the same except that while the individualized model seeks to promote mastery learning of a pre-specified set of objectives for each learner in a subject or course, the Group-Based model seeks to promote mastery learning of a unit of instruction for all members of a class or group in a subject or course. This study used the group based model of mastery learning and lecture method to compare the effectiveness of the two methods on the students' academic achievement in Chemistry.

Academic achievement refers to the learning outcomes of students which include the knowledge, skills and ideas acquired and retained through a course of study within and outside the classroom situation (Hassan, Mannir, Akinduro and Sanni, 2021). Academic achievement could be high, average or low/poor. A high academic achievement as one where the score is above the pass mark while a poor academic achievement is any performance score that falls below a desired standard or pass mark.

Ironically, despite the importance of Chemistry in national development and everyday life, numerous reports by researchers such as Udo and Udofia (2014); Ojukwu(2016); Muhammad(2020); Nja, Cornelius-Ukpebi, Edoho and Neji(2020) and Chikendu(2022) showed declining students' performance in the subject. Majority of the studies attributed the possible causes of candidates' persistent poor performances in Chemistry to the use of poor instructional strategies by teachers.

Muhammad (2020) posted that eighty percent of the scientific information that students receive form their teachers in Nigerian secondary schools come through the lecture method. This viewpoint is shared by Nja, Cornelius-Ukpebi, Edoho and Neji, (2020) and Chikendu, (2022) who contended that lecture method is the most widely used method for teaching chemistry in most secondary schools in Nigeria, hence the need to use it as a control in this study. The use of the lecture method by most chemistry teachers lead to the teaching of the subject as a body of abstract topics, only to be memorized by the students and regurgitated during examinations.

It is pertinent to note that although the lecture method is very good for teaching large classes and for easy coverage of the syllabus as pointed out by Muhammad (2020), it is widely criticized by science educators as being ineffective for enhancing students' achievement. The author noted that the lecture method is characterized by "one-way communication" where the teacher does most of the talking while the students more often assume a passive role. The students may not be given ample opportunity to ask questions and express their opinions which make it to be in contrast with modern student-centred teaching methods which require less talk on the part of the teacher and more activities on the part of the students.

Students' academic achievement in science subjects may vary according to gender. Gender is the socially constructed differences between males and females. Studies abound on gender differences and students' achievement in science subjects but their findings are conflicting. While some studies such as Ogini, Akinola, Fadiji& Amole (2021) and Nkok (2022) reported that there is no significant difference in achievement between male and female students in science subjects, others like Udo and Udofia (2014) and Iserameiyaa and Ibeneme (2018) found that there was significant difference between boys and girls in their academic achievement. In

view of these controversial findings, there is need for more investigation with respect to mastery learning strategies and students' academic achievement in chemistry.

Several studies have reported that mastery learning strategies could be used to enhance students' academic achievement in many science subjects such as Physics (Wambugu and Changeiywo, 2008); Mathematics (Toheed and Ali, 2019; Ogini, Akinola, Fadiji & Amole, 2021); and Basic Technology (Iserameiyaa and Ibeneme, 2018; Iserameiyaa and Uwameiye, 2018). However, not much work has been done on the effect of mastery learning instructional strategy on students' academic achievement in Chemistry in secondary schools in Akwa Ibom North West Senatorial District. It therefore becomes imperative to explore the efficacy or otherwise of mastery learning instructional strategies on students' academic achievement in this study area.

Statement of the Problem

Chemistry students are expected to be proficient in the subject in both internal and external examinations to enable them function effectively in the contemporary technological society. It is however disheartening to observe that students' academic achievement in Chemistry in the senior secondary school certificate examinations are below expectation. Reports from examination bodies like the West African Examinations Council (WAEC) and National Examinations Council (NECO) indicate a consistently poor students' achievement in Chemistry (WAEC, 2005, 2008, 2009 and 2015). This has been an issue of great concern to science educators considering the relevance of Chemistry education to the nations' development.

Several scholars such as Muhammad (2020); Nja, Cornelius-Ukpebi, Edoho and Neji (2020); Egolum, Samuel and Okonkwo (2021) and Chikendu (2022) attribute the poor students' achievement in Chemistry to the use of poor instructional strategies by most chemistry teachers. It is observed that the commonly used teaching method adopted by chemistry teachers in secondary schools in Akwa Ibom North West Senatorial District is the lecture method. The use of the lecture method in teaching Chemistry partly account for the apathy shown by many students towards Chemistry which culminate in their poor achievement in the subject. On this basis, there is need to explore new strategies such as mastery learning instructional strategies. Therefore the problem to which this study is addressed is to ascertain the effects of mastery learning strategies on students' academic achievement in Chemistry in secondary schools in Akwa Ibom North east Senatorial District

Purpose of the Study

The main purpose of the study was to examine the effect of mastery learning strategy on Secondary Schools students' achievement in Chemistry in Akwa Ibom North East Senatorial District. The specific objectives of the study are:-

1. To determine the difference between the mean achievement scores of students in Chemistry when taught with Mastery Learning Strategies and the conventional lecture method.
2. To determine the difference between the mean achievement scores of male and female students in Chemistry when exposed to Mastery Learning Strategies and conventional lecture method
3. To determine the interaction effects of teaching methods and gender on the mean achievement scores of students in Chemistry.

Research Questions

The following research questions guided the study:-

1. What is the difference between the mean achievement scores of students in Chemistry when taught with Mastery Learning Strategies and conventional teaching method?
2. What is the difference between the mean achievement scores of male and female students in Chemistry when exposed to Mastery Learning Strategies and conventional method of teaching?
3. What is the interaction effect of teaching methods and gender on the mean achievement scores of students in Chemistry?

Hypotheses: The following null hypotheses formulated to guide the study were tested at 0.05 level of significance:

HO 1: There is no significant difference between the mean achievement scores of students in Chemistry when taught with Mastery Learning Strategies and conventional teaching method.

HO 2: There is no significant difference between the mean achievement scores of male and female students in Chemistry when exposed to Mastery Learning Strategies and conventional method of teaching.

HO3: There is no significant interaction effect of teaching methods and gender on the mean achievement scores of students in Chemistry.

Research Methodology

The quasi experimental, pre-test, post-test research design was adopted in the study. The study was conducted in AkwaIbom North East Senatorial district, Nigeria. The population of the study comprised all the 2,536 SS3 Chemistry students in all the 75 public secondary schools in AkwaIbom North East Senatorial district in the 2021/22 academic session. The sample consisted of 100 students (62 males and 38 females). The sample was selected from two intact classes in two co-educational secondary schools in the study area through purposive sampling technique.

The instruments for data collection consisted of mastery learning lesson plans, conventional lesson plans and a Chemistry Achievement Test (CAT). The mastery learning lesson plans constituted the treatment that was given to the experimental group while the control group were taught with the conventional lesson plans. The Chemistry Achievement Test which contained 25 multiple choice items was used as pre-test and post-test after being reshuffled. The lesson plans were face validated by three lecturers from the Faculty of Education, Abia State University, Uturu. The reliability of the Chemistry Achievement Test obtained through test-retest method was 0.74 which indicated that the instrument was very reliable for use in the study. Students in both groups were first given the pre-test before they were taught the same topics for three weeks after which the post-test was administered on the students. The scores of each student in the pre-test and post-test were recorded and used for ANCOVA) at 0.05 level of significance.

Data Analysis: The data collected was analysed using mean and standard deviation for answering the research questions while the null hypotheses were tested using Analysis of Covariance

Results

Research Question 1: What is the difference between the mean achievement scores of students in Chemistry when taught with Mastery Learning Strategies and conventional teaching method?

Table 1: Mean Performance scores of students in Chemistry when taught with mastery learning method and the conventional lecture method

S/n	Group	N	Pretest \bar{X}	SD	Post-test \bar{X}	SD	Mean Gain
1	Experimental	66	28.68	1.05	46.13	1.27	17.45
2	Control	38	28.45	1.45	40.03	0.14	11.58

The data in Table 1 shows that the mean pre-test and mean post-test scores of students in the experimental group who were taught with mastery learning method are 28.68 and 46.13 respectively with standard deviations of 1.05 and 1.27. The corresponding figures for students in the control group who were taught with lecture method are 28.45 and 40.03 respectively with standard deviations of 1.45 and 0.14 respectively. It could be observed that students who were taught with mastery learning had a higher mean gain of 17.45 as against 11.58 obtained by those who were taught with lecture method. This result suggests that teaching Chemistry using mastery learning method enhances students' academic achievement in Chemistry than using lecture method

Research Question 2: What is the difference between the mean achievement scores of male and female students in Chemistry when exposed to Mastery Learning Strategies and conventional method of teaching?

Table 2: Mean achievement scores of male and female students in Chemistry when taught using mastery learning and lecture methods

S/n	Group	Gender	N	Pre-Test \bar{X}	SD	Post-test \bar{X}	SD	Mean Gain
1	Experimental	Male	47	28.62	1.93	46.11	1.06	17.49
		Female	19	28.87	0.76	46.20	0.18	17.33
2	Control	Male	23	18.54	1.25	30.69	1.49	12.15
		Female	15	18.26	1.07	31.68	0.88	13.42

The data in Table 2 shows that the mean pre-test and post-test score of male students in the experimental group who were taught with Mastery Learning is 28.62 and 46.11 respectively with standard deviation of 1.93 and 1.06 making a mean gain of 17.49. The corresponding scores for their female counterparts are 28.87 and 46.20 respectively with standard deviations of 0.76 and 0.18 making a mean gain of 17.33. Table 2 also shows that male students in the control group who were taught with lecture method had a mean pre-test and post test scores of 18.54 and 30.69 respectively with standard deviation of 1.25 and 1.49 making a mean gain of 12.15 while their female colleagues had a mean pre-test and post-test scores of 18.26 and 31.68 with standard

deviations of 1.07 and 0.88 respectively. It could be observed that male students in the experimental group had a higher mean gain than their female counterparts while the female students in the control group had a higher mean gain than their male counterparts. This result suggests that teaching Chemistry using Mastery Learning favours the male students more than the females while the lecture method favours the female students more than the males.

Hypothesis 1

HO 1: There is no significant difference between the mean achievement scores of students in Chemistry when taught with Mastery Learning Strategies and conventional teaching method.

Table 3: Analysis of Covariance of the Mean achievement Scores of Students in Chemistry When Taught with Mastery Learning and lecture Methods

Source	Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	1126.23	2	563.11	11.69	0.00	
Intercept	22811.77	1	22811.77	473.73	0.00	
PRE_TEST	29.24	1	29.24	.61	0.44	
GROUP	1125.89	1	1125.89	23.35	0.00	S
Error	4189.37	87	48.15			
Total	317898.00	90				
Corrected Total	5315.60	89				

S = Significant at 0.05 level of significance

The result of the analysis of covariance presented in Table 3 shows that the f -value for group or method is 6.49 with p- value (level of significance) being 0.01. Since the obtained p- value is less than the stipulated probability level of 0.05, the null hypothesis is rejected. This implies that there is significant difference between the mean achievement scores of students in Chemistry when taught with Mastery Learning Strategies and conventional teaching method. The difference is in favour of those in the experimental group.

Hypothesis 2 and 3

HO 2: There is no significant difference between the mean achievement scores of male and female students in Chemistry when exposed to Mastery Learning Strategies and conventional method of teaching.

HO3: There is no significant interaction effect of teaching methods and gender on the mean achievement scores of students in Chemistry.

Table 4: Analysis of Covariance Test for Significant Difference between male and female students' mean achievement in chemistry and Interaction Effect of teaching method and Gender on their mean achievement

Source	Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	1170.18	4	292.54	85.87	0.00	
Intercept	745.24	1	745.24	218.75	0.00	
PRE_TEST	5.49	1	5.49	1.61	0.20	
GROUP	1010.68	1	1010.68	296.66	0.00	
GENDER	22.13	1	22.13	6.49	0.01	S
GROUP *						
GENDER	28.28	1	28.28	8.30	0.01	S
Error	391.79	115	3.41			
Total	22418.00	120				
Corrected Total	1561.97	119				

*S = Significant at 0.05 level of significance

The data in Table 4 revealed that the f -value for gender is 6.49 with p- value (level of significance) being 0.01. Since the obtained p- value is less than the stipulated probability level of 0.05, null hypothesis 2 is rejected. This implies that there is significant difference in students' achievement in chemistry when taught using Mastery Learning and lecture method based on their gender.

Table 4.also shows that the f-value for interaction effect of teaching method and gender is 8.30 with p-value ((level of significance) being 0.01. Since the obtained p- value is less than the stipulated probability level of 0.05, null hypothesis 3 is rejected. This implies that there is significant interaction effect of teaching method and Gender on students achievement in chemistry.

Discussion of Findings

In the study, it was found that there is significant difference in students' achievement in chemistry when taught using Mastery Learning and lecture method in favour of those taught with master learning strategy. This result could be attributed to the fact that mastery learning method enables students to understand a unit of instruction very well before proceeding to the next unit. This finding agrees with that of Toheed and Ali (2019) and Ogini, Akinola, Fadiji and Amole (2021) who in their separate studies found that mastery learning strategy enhance students' academic achievement in Mathematics more than the lecture method.

It was also found in the study that there is significant difference in students' achievement in Chemistry when taught using Mastery Learning and lecture method based on their gender. This was in favour of the male students. These findings support that of Udo and Udofia (2014) who reported that male students performed better than their female counterparts in Chemistry when taught with the mastery learning strategy. This finding however contradicts that of Ogini, Akinola, Fadiji and Amole (2021) who found that there is no significant difference in students' achievement in Mathematics when taught using Mastery Learning and lecture method based on their gender.

It was further found in the study that there is significant interaction effect of teaching method and Gender on students' academic achievement in Chemistry. This implies that the combination of both teaching methods and gender have significant influence on students' achievement in Chemistry. This finding supports that of Udo and Udofia (2014) and Iserameiya and Ibeneme(2018) who found that there was significant interaction effect of gender and teaching methods on students' achievement in Chemistry and Basic technology respectively.

Conclusion

Based on the findings of the study, it is concluded that teaching Chemistry using mastery learning method enhances students' academic achievement than using the lecture method. Also, teaching Chemistry using Mastery Learning favours the male students more than the females while the lecture method favours the female students more than the males. Moreover, there is significant interaction effect of teaching method and gender on students achievement in chemistry when taught using Mastery Learning and lecture methods.

Recommendations:

The following recommendations are made based on the findings of the study.

1. Chemistry teachers in Akwalbom state secondary schools should henceforth adopt the mastery learning strategy in teaching important topics in Chemistry
2. Chemistry teachers should be de-emphasize the use of the conventional methods of teaching.
3. Curriculum developers in Chemistry should include Mastery learning as one of the teaching methods in order to improve students achievement in the subject.

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