

Effect of Mastery Learning on Secondary School Students' Academic Performance and Retention in Basic Science and Technology in Etinan Local Government Area

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Abstract

This study investigated the effect of mastery learning on secondary school students' academic performance and retention in basic science and technology in Etinan Local Government Area. Three research questions and three null hypotheses gave direction to the study. Quasi experimental research design was adopted for the study. The study sample comprised 220 students selected using simple random sampling technique. The instrument for data collection was Basic Science and Technology Performance Test with a reliability index of 0.87 obtained using test-retest method. Data collected were analyzed using mean, standard deviation and independent t-test. Findings showed that students who were taught basic science and technology using mastery learning had better performance and retention scores than those who were taught using the expository method. Gender had no significant influence on the academic performance of students taught basic science and technology using mastery learning. It was recommended among others that teachers should adopt mastery learning strategy to improve students' academic performance in basic science and technology.

Keywords: Mastery learning, Learning Retention and Gender.

Introduction

The level of development of a nation relies on the strength of her science education. Science is a body of organized knowledge obtained through observation and experimentation. The Science Council (2023) defined science as the pursuit and application of knowledge and understanding of the social and natural world following an orderly procedure based on evidence. Science provides knowledge and technology provides ways of using this knowledge. Development and advancement in technology depends on science, this implies that without science, there is no technology. Nigeria is a developing country, for her to have the ability to compete technologically with the rest of the world and to attain the level of a developed country, she must develop scientifically and technologically; and the only way of doing this is to strengthen science education which is the gateway for self-reliance and self-sufficiency.

Basic science and technology is the foundation for science related courses in the senior secondary school. It prepares students for science and technology subjects like Biology, Chemistry, Physics, health education, computer studies, technical drawing and others. The essence of integration of the science curricula is to present science in a holistic and unified way to students at the basic education level to

enable them understand contemporary issues in the world. Despite the importance of Basic Science and Technology to national development, the overall performance of junior secondary school students in external examination is not encouraging. This poor performance of students in basic Science and Technology portends adverse consequences on the students and the society at large since the knowledge of Basic Science and Technology is essential for Nigeria's scientific and technological development. Aibuede and Tina (2017) in an attempt to survey the factors affecting the poor performance of students in basic science and technology reported the following findings: Government do not often train and retrain basic science and technology teachers, most teachers in primary and secondary schools are not qualified to teach basic science and technology, insufficient quantities of modern reading and learning aids and poor methods of teaching basic science and technology. Mgimba (2021) noted that teaching method is the most important factor that affects the academic performance of students. The argument is that a good teacher can help close the achievement gap that results from other factors. One of the teaching methods that can guarantee effective learning of basic science and technology is mastery learning (Ndioho & Obioha, 2020).

Mastery learning was propounded by Benjamin Bloom in 1968, the theory states that all students can understand what they are taught if they are placed under suitable learning conditions. The theory suggests that if teachers are able to give adequate learning conditions, almost all students would perform well and the gap in their levels of performance would vanish. Bloom states that the requirement to the development of mastery learning is to explain the meaning of mastery, state the objectives and content of instruction and outline the standard accepted as mastery so that the teacher will be able to know if a student has mastered a concept or not. The materials the students are to learn within a given period should be split into smaller bits and benchmark for performance should be clearly stated, then formative tests should be given to the students during the teaching of each unit of learning. The result of the formative tests should provide feedback to the teacher and the students. This will enable the teacher to find out if the students have gained mastery or not and to enable the students know the aspects they are not doing well and will need to improve upon. The students that did not gain mastery are taught again based on the identified areas of difficulties from the results of the formative test and the test is re-administered to them. The corrective instruction could be done through peer tutoring, small group discussion, re-teaching, homework and other suitable ways. Bloom contended that if this method is used in teaching students almost all the students will attain a high level of learning.

Agboghroma (2014) investigated the effects of Mastery Learning instructional strategy on students' Achievement in Integrated Science and reported that students who were taught using mastery learning performed significantly better than the control. Similarly, Ikechukwu (2020) examined the effect of mastery learning strategy on academic achievement of Junior Secondary School two students in Basic science. The results showed that students taught Basic science using mastery learning strategy performed significantly better than those taught using conventional teaching method. Studies also indicated that mastery learning enhances retention. For instance Ndioho and Obioha (2020) reported a significant difference on the mean retention scores of students in favour of mastery learning while examining the effect of mastery learning approach on Biology students' retention in secondary schools in Rivers State. Jack (2020) reported a significant difference in favour of mastery learning while investigating the effect of Mastery Learning Instructional Strategy on secondary school

students' achievement and retention of Chemistry concepts. There was also no significant difference between the mean achievement scores of male and female students in chemistry

Learning retention is the process of taking information and being able to remember it in the future. Bastanzhiyeva (2020) defined learning retention as a process by which acquired information is transferred from one's short-term memory to their long-term memory in such a way that it can easily and quickly be retrieved when needed. To Haqie (2021) learning retention is about making new information cleave and finding adequate ways to do this. The most important aspect of learning is for it to be retained over time. If what a teacher teaches does not result in the students being able to retain knowledge over time, then the students have not really learned. Assessing retention rate is very important because it helps one to understand that some forms of learning are more effective than others in helping students retain knowledge. The most important determinant of retention is the learning strategy adopted by the teacher. Recently, researchers have found that strategies that combine studying with testing were optimal for developing retention of learned concepts. Research demonstrates that students who write tests often perform better than students in non-testing learning conditions (Adesope, Trevisan and Sundararajan, 2017).

Gender was an intervening variable in this study; gender refers to the social attributes and opportunities associated with being male and female. It refers to the culturally and socially constructed features and roles which are attributed to males and females in any society. Inconsistent research findings have been reported on the relationship between gender and academic ability. Iserameiya and Ibeneme (2018) observed that female students taught basic science and technology with Mastery learning strategy performed relatively higher in their post-test academic achievement than the male students. Ndioho and Obioha (2020) reported that the mean retention score of female students was significantly higher than the male students when taught Biology with mastery learning approach. Ikechukwu (2020) reported that the mean achievement scores of Male and female students taught basic science and technology using mastery learning and conventional method did not differ significantly.

Research Questions

1. What difference exist in the mean performance score of students taught Basic Science and Technology using Mastery

- Learning and those taught using expository teaching method?
2. What difference exists in the mean performance scores of male and female students taught Basic Science and Technology using Mastery Learning?
 3. What difference exists in the mean retention scores of students taught Basic Science and Technology using Mastery learning and those taught using expository teaching method?

Research Hypotheses

The following null hypotheses were formulated to guide the study;

1. There is no significant difference in the mean performance score of students taught Basic Science and Technology using Mastery Learning and those taught using expository teaching method.
2. There is no significant difference in the mean performance scores of male and female students taught Basic Science and Technology using Mastery Learning.
3. There is no significant difference in the mean retention scores of students taught Basic Science and Technology using Mastery learning and those taught using expository teaching method.

Methodology

The research adopted Quasi-experimental non-equivalent control group design. The study was carried out in Etinan local government area, Akwa Ibom state. The population of the study was 2,220 Junior Secondary Two Students from all the public co-educational secondary schools in the study area. There are eleven public co-educational secondary schools in the study area, 4 public co-educational secondary schools were randomly selected while 220 formed the sample size for the study. The selected schools were randomly assigned to the experimental and the control group and one intact class was used from each school. Two intact classes for experimental group were taught with Mastery Learning and two intact classes for the control group were taught with Expository method. The instrument used for data collection was researcher made instrument tagged 'Basic science and Technology Performance Test' (BSTPT). It consisted of 20 multiple choice items with 4 options. The BSTPT was reshuffled and re-administered to the students three weeks after the performance test as 'Basic Science and Technology Retention Test'. The instrument was validated using content and face validity. The face validity was done by three experts while the content validity was

established using the test blue print. The reliability of the instrument was determined using test-retest method. To achieve this, the research instrument was administered to twenty students in a community school in the study area that was not among the samples schools. After an interval of two weeks, the instrument was re-administered to the same sample. The initial and retest scores of the subjects were correlated using Pearson product moment correlation and a reliability index of 0.87 was obtained. The respondents were to tick the correct answer from the options given. Each correct answer carried one (1) mark and was converted to percentage. The statistical tools used were 67 mean, standard deviation and independent t- test.

Results

Table 1: Mean, Standard Deviation and Mean Difference for Mastery Learning and Expository Teaching method

Variables	N	\bar{X}	SD	Mean Diff.
Experimental	110	65.45	8.38	11.31
Control	110	54.14	10.50	

The result shown in table 1 indicates that the mean of the students taught basic science and technology using mastery learning was 64.45 while that of expository teaching method was 54.14. The result also shows that the mean difference between the two groups was 11.31. This showed that those in mastery learning group perform better than those in control group taught with expository teaching method.

Table 2: Mean and standard deviation of male and female students taught basic science and technology using mastery learning.

Variables	N	\bar{X}	SD	Mean Diff.
Male	60	66.50	9.31	1.65
Female	50	64.85	8.85	

The result in table 2 indicates the mean score of both male and female students as 66.50 and 64.85 respectively. The mean difference is 1.65. Whether the observed difference in the mean scores



was statistically significant is assessed by the results for testing of hypothesis two.

Table 3: Mean retention score and standard deviation of basic science and technology students taught using mastery learning and expository teaching method

Variables	N	\bar{X}	SD	Mean Diff.
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Mastery	110	60.14	6.38	
Expository	110	40.50	10.27	19.64

The result shown in table 3 indicates that the mean retention score of the students taught basic science and technology using mastery learning was 60.14 while that of expository teaching method was 40.50. The results also revealed that the mean difference between the two groups was 19.64

Table 4: t- test analysis of the difference in the mean performance score of students taught Basic Science and Technology using Mastery Learning and those taught using expository teaching method

Variables	N	\bar{X}	SD	t-cal	t-crit	Df	Decision
Experimental	110	65.45	6.38	8.34	1.97	218	Rejected
Control	110	54.14	10.50				

Table 4 shows that the t-calculated (t-cal=8.34) is greater than the t-critical (t-crit=1.97) given 218 degree of freedom at 0.05 level of significance, hence the null hypothesis is rejected while the alternate hypothesis which states that There is a significant

difference in the mean performance score of students taught Basic Science and Technology using Mastery Learning and those taught using expository teaching method is accepted.

Table 5 t-test analysis of the difference in the mean performance scores of male and female students taught Basic Science and Technology using Mastery Learning.

Variables	N	\bar{X}	SD	t-cal	t-crit	Df	Decision
Male	60	66.50	7.31	0.72	1.97	108	Accepted
Female	50	64.85	5.85				

Table 5 shows that the t-calculated (t-cal = 0.72) is less than the critical value (t-crit=1.97) given 108 degree of freedom at 0.05 level of significance, hence the null hypothesis which states that There is no

significant difference in the mean performance scores of male and female students taught Basic Science and Technology using Mastery Learning is accepted.

Table 6: t test analysis of the difference in the mean retention scores of students taught Basic Science and Technology using Mastery learning and those taught using expository teaching method.

Variables	N	\bar{X}	SD	t cal	t crit	Df	Decision
Mastery	110	60.14	7.11	6.29	1.97	218	Rejected
Expository	110	40.50	10.27				

Table 6 shows that the t-calculated ($t\text{-cal}=6.29$) is greater than the t-critical ($t\text{-crit}=1.97$) given 218 degree of freedom at 0.05 level of significance, hence the null hypothesis is rejected while the alternate hypothesis which states that There is a significant difference in the mean retention scores of students taught Basic Science and Technology using Mastery learning and those taught using expository teaching method is accepted.

Discussion

The findings of this study indicated that there was significant difference in the academic performance of students exposed to mastery learning instructional strategy and expository teaching strategy. Students exposed to mastery learning performed significantly better than those exposed to conventional teaching strategy. This might be as a result of mastery learning having the features of formative assessment and peer tutoring which aided the students in comprehension, assimilation and retention of the concept taught. The result of this study agrees with the findings of Ikechukwu (2020) who reported that student taught basic science and technology using Mastery learning outperform their counterpart in the control group.

Also, there is no significant difference in the mean performance scores of male and female students taught Basic Science and Technology using Mastery Learning. This observation indicates that gender is not a strong determinant of students' academic performance taught using mastery learning. The finding of the study is in line with Ikechukwu (2020), who reported that gender was not a significant factor on the academic performance of students taught basic science and technology using mastery Learning Strategy. However, the findings of this study disagrees with that of Iserameiya and Ibeneme (2018), who reported that gender had a significant influence on students' performance with the females performing better than their male counterparts. Also, a significant difference was found in the mean retention scores of students taught Basic Science and Technology using Mastery learning and those taught using expository teaching method. The result may be attributed to the formative test given to students while monitoring their progress. The result of this study agrees with the earlier findings by Ndioho and Obiora (2020) who reported that mastery learning has significant effect on students' retention in Biology.

Conclusion

Based on the findings, it was concluded that mastery learning has significant effect on basic science and technology students' academic

performance and retention. Also, mastery learning has no significant effect on students' gender. Both male and female students benefitted equally from the instruction.

Recommendations

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

1. Basic Science and Technology Teachers should adopt mastery learning instructional strategy in the teaching of science concepts to enable the students to learn meaningfully to improve their academic performance.
2. Seminars, workshops and conferences should be organized by the Ministry of Education, Management of institutions, Government and NGOs to create awareness on the use of mastery learning approach in the teaching of science subjects.

References

- Agboghoroma, T. E. (2014). Mastery learning approach on secondary students' Integrated Science achievement. *British Journal of Education*, 2(7):80-88
- Aibuedefe, A. F. and Tina, A. E. (2017). Current challenges in Science and technology education in Nigeria. *Journal of Science and Technical Education* 10(7):39-44
- Adesope, O. O., Trevisan, D. A. and Sundararajan, N. (2017). Rethinking the use of tests. A meta-Analysis of practice. *Review of Educational Research*.
<https://www.doi.org/10.3102/003465316689306>. (Retrieved on 22nd October, 2021).
- Bastanzhyieva, D. (2020). How to improve learning retention. [https://raccoongang.com>blog>html/.....](https://raccoongang.com/blog/html/.....) (Retrieved 20th October, 2021).
- Haqie, A. (2021). What is learning retention. <https://www.lorman.com>blog>post>. (Retrieved 20th October, 2021)
- Ikechukwu, C. and Onuabuchi, A. (2020). Effect of mastery learning strategy on junior secondary students academic in basic science and technology in Enugu state. *International Journal of Science and Technology*, 8(10):20-29.
- Iserameiya F., and Ibeneme. O. T. (2018) "Effect of Mastery Learning Strategy on Junior secondary School Students' Academic Achievement in Basic Technology in Edo State, Nigeria. *International Journal of New Technology and Research*, 4(10): 12-20.
- Jack, G. U (2020). The effect of Mastery Learning Instructional Strategy on secondary school students' achievement and retention of



Chemistry concepts. *Journal of Research in Science Education*, 12(8): 6-17.

Mgimba, H. (2021). The effects of financial control on financial performance of secondary schools Arumeru Arusha. <https://www.researchgate.net/publication>. (Retrieved 30th November, 2022)

Ndioho, O. N. and Obioha, T. E. (2020). Mastery learning approach and Biology students'

retention in secondary schools in Gokana local government area rivers state. *International Journal of Multidisciplinary Research and Development*, 7(3): 106-109.

The Science Council (2023). Our Definition of Science.

<https://www.Sciencecouncil.org>about-> (Retrieved 20th January,2023)