International Journal of New Technology and Research (IJNTR)
ISSN:2454-4116, Volume-4, Issue-3, March 2018 Pages 95-101

Effect of Mastery Learning Strategy on Junior Secondary School Students' Academic Achievement in Basic Technology in Edo State, Nigeria

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***Abstract*— The need to enhance academic achievement of students in Basic Technology in Edo State necessitated this study; it focused on the effect of mastery learning strategy on academic achievement of Junior Secondary School Two (JSSII) students' in Basic Technology (BTE). Four research questions guided the study and two null hypotheses formulated were tested at 0.05 level of significance. Quasi-Experimental design was adopted. Specifically, Solomon Four non equivalent group design model was used. The population was 3,170 (1,675 male & 1,495 female) JSS II students from 25 schools in Edo Central Edo State. A sample size of 119 (66 male, 53 female) JSS11 students from two selected mixed schools participated in this study. Stratified sampling technique was used. A 50-item multiple choice Basic Technology Achievement Test (BTEAT) was used for both the pre-test and post-test. The instrument was face and content validated before administration. Test – retest method was used to establish the reliability of the instrument. Pearson product moment correlation coefficient was used to correlate the two results and a reliability index of 0.85 was obtained. Experimental group E_1 and control group C_1 received pre-test before commencement of the treatment, post-test was administered to all the groups. Data collected were analyzed with descriptive and inferential statistics (mean, mean difference t-test and Analysis of Covariance (ANCOVA). It was found out that students taught BTE using MLS differ significantly in their post-test academic achievement compared to those taught using DIS. Students taught BTE with MLS exposed to pre-test performed relatively higher in their post-test academic achievement than those exposed to post test only. Also, there was a significant interaction effect between MLS and students academic achievement in BTE. Furthermore, there was a significant interaction effect between pre-testing and instructional strategy (MLS) on students' academic achievement in BTE. Based on the findings, it was concluded that MLS is an effective instructional strategy that significantly enhances students' academic achievement, irrespective of the subjects. Therefore, the use of MLS is recommended, and this may require developing teachers' capacity for effective administration.**

***Index Terms*— Mastery Learning Strategy, Analysis of Covariance .**

I. INTRODUCTION

Technological advancement has suddenly transformed the world into a knowledge society and a competitive world. Nations globally are facing technological challenges; consequently, there is an atmosphere of uncertainty. School systems and individuals are constantly under pressure for continuous learning, any nation that does not take the development of her technology as a serious matter will find her citizens being relegated to the back bench in committee of nations. Therefore knowledge of Basic Technology is a crucial requirement in all countries because technological advancement of any nation depends hugely on her ability to transform its resources into practical reality, which guarantees its self sustenance and viability (Ogbuanya & Okoye, 2015).

Technology is a systematic approach to using procedures and tools to accomplish a particular goal. According to Mustafa (2008), technology is a process of practical application of scientific knowledge in creating and manipulating natural resources of matter, energy and natural phenomena to solve human problems. Basic Technology is the bedrock of technology, it is an integral part of technology, which exposes and prepares students' mind for future career in technology. Basic Technology is designed for the acquisition of basic literacy in technology through exploration (Uwameiye, 2010).

Basic Technology is offered at the junior secondary school (JSS) levels, an aspect of secondary education designed to lay solid foundation for further education. Basically secondary education system primary responsibility is building solid foundation through the exploration of various teaching and learning strategies that promote individual learning ability (FRN, 2012). If a solid foundation is not laid now in the teaching and learning of Basic Technology talented children in Edo State are likely to be disadvantaged technologically. According to Lamidi, Oyelekan and Olorundare (2015), learners generally operate at different levels of intelligence and their ability to perform specific tasks also differs. It is also apparent that science and technology cannot thrive without using the appropriate instructional strategies to teach the students. Hence, the need to conduct researches that put various instructional strategies to test. Among these are Direct Instruction Strategy (DIS) and Mastery Learning Strategy.

Direct Instruction Strategy (DIS) is a primary teaching and learning strategy under the teacher-centered approaches. It is a general term that refers to conventional teaching and learning strategy, which relies on explicit teaching through lecture and teacher-led demonstrations (Kinder, Kubina & Marchand-martella, 2005). Direct Instruction Strategy (DIS) is a regular teaching strategy,

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effective in teaching basic and fundamentals skills across all content areas. It is characterized by insisting that all students be taught the same materials at the same rate. It incorrectly assumes that for every ounce of teaching, there is an ounce of learning. Direct Instruction Strategy seems not to be achieving scientific and technological literacy much needed today because of its theoretical nature, teacher- centeredness'. Most times students are exposed to the basic science and technology without practical knowledge and active participation (Adeyemo & Babajide, 2014). Sustainability of basic science and technology depends on regular use of appropriate instructional strategy and instructional strategies are strong determinable factors of students' level of mastery lesson content and academic achievements (Agboghoroma, 2014).

Instructional model called Mastery Learning Strategy (MLS) is rooted on Carroll's and Bloom's learning for mastery model in the 1960s. This model of school learning assumes that students differ in the amount of learning time they need and that all students are potential academic achievers if given appropriate time and instructional opportunities that suit their learning style. If these differences are to be adequately taken account of, considerable skill in classroom and time management is required of teachers (Carroll cited in Goliath, 2007). Mastery learning strategy is learning strategy that provides quality instructions, immediate feedback and remedial lessons for effective attainment of lesson objectives (Abakpa & Iji, 2011). From the above concepts MLS is rooted on the beliefs that all students are potential achievers if given the appropriate time and instructional strategy that suit their learning style. In MLS, instructional approaches and learning time are varied, based on the result from each formative assessment. Variety of learning activities and instructional strategies like cooperative learning, peer tutoring, individualistic learning programmed learning and innovative learning style amongst others are used (Amiruddin & Zainudin, 2015). Furthermore, for this study re-teaching, instructional variation, peers tutoring, group discussion, individual home work assignment procedures were adopted as remediation.

II. Statement of the Problem

Unsatisfactory academic achievements amongst junior secondary school students in Basic Technology (BTE) may be attributed to students' differences in their learning styles, use of inappropriate instructional strategies, amongst other factors. These factors are militating against the successful actualization of the objectives for which BTE was introduced into JSS education. Basic Technology teachers seem to engage little favorable teaching strategies in their process of teaching and learning, hence the unsatisfactory academic achievement in Basic Technology. According to Karega (2008), one way of addressing the learning difficulties that students experience in science based classrooms is through appropriate teaching strategy interventions.

The teaching approach that a teacher adopts is one factor that may affect students' motivation and academic achievement (Wambugu, 2006). This makes it imperative to seek for appropriate instructional strategies that could enhance students' academic achievement in BTE. Fortunately, in recent time many modern learning strategies have been proved useful, among such is MLS, on this platform of undeniable facts, this study was conceived to ascertain whether the used of MLS in teaching BTE would yield appreciable result. Nations like Kenya, Japan and USA are noting appreciable improvements in the academic achievement of students in science based subjects with the use of MLS. The problem of the study put as question is; would the use of mastery learning strategy in teaching basic technology yield appreciable enhanced results in students' academic achievement?

A. *Purpose of the Study*

To determine the effect of mastery learning strategy on academic achievement of junior secondary school students' in basic technology in Edo State, Nigeria. Specifically, the study determined

I. The pre-test and post-test academic achievement mean scores of students taught Basic Technology (BTE) using Direct Instruction Strategy (DIS) and those taught using Mastery Learning Strategy (MLS)

II. The post- test academic achievement mean scores of students taught BTE with Mastery Learning Strategy and without pre-test

3 The difference in the pre-test/ post-test academic achievement mean score of students taught BTE using MLS and those taught with DIS.

4. The difference in the post-test academic achievement mean scores of BTE students exposed to pre-test/post-test and those exposed to post - test only using MLS.

5. The interaction effect of pre-testing and instructional strategy (MLS) on students' post-test academic achievement mean scores in BTE.

B. *Significance of the Study*

Findings of this study would benefit Basic Technology teachers, students, educational administrators, and future researchers.

This study when published would be used to guide teachers on the need for using formative assessment as instructional tool in teaching BTE. When teachers use MLS in teaching it would make their job become easier and interesting with the use of immediate feedback and formative assessments.

When the findings of this study are put to practice in schools, it would be of benefit to students in developing their interest on self learning, unity, and creative habits. When formative and corrective feedback is immediately made available to students, each student would have a detailed prescription of what more is needed to be done to master learning unit goals, and would as well help them to prevent minor learning difficulties from accumulating to major learning difficulties. It would also help to awaken their individual self concept and confidence to face future challenges.

The findings of this study when implemented would benefit government in that it would positively influence students' attitude towards technology and learning generally. It would help in achieving junior secondary school education

objectives. Thereby leading to peaceful living, meaningful self –reliance citizens. Finally, findings of this study would also encourage future researchers by providing relevant literature for related studies.

C. Scope of the Study

This study was delimited to the effect of mastery learning strategy on academic achievement of Junior Secondary School two (JSS II) students in Basic Technology in Edo State. It covered six selected topics in Basic Technology as specified in their syllabus. The topics were taught for six weeks. The study also determined the interaction effects of pretesting and instructional strategy (MLS) on students' academic achievement in Basic Technology.

D. Research Questions

The following research questions guided the study:

1 What are the pre-test and post-test academic achievement mean scores of Students taught Basic Technology (BTE) with Direct Instruction Strategy (DIS) and those taught with Mastery Learning Strategy (MLS)?

2 What is the post test academic achievement mean score of students taught BTE with Mastery Learning Strategy without pre-test?

3 What is the difference between post-test academic achievement mean scores of students taught BTE with MLS and those taught with DIS?

4 What is the difference between the post-test academic achievement mean score of BTE students exposed to pre-test/post- test and those exposed to post- test only using MLS?

III. HYPOTHESES

The following null hypotheses were tested at 0.05 level of significance

1 There is no significant difference between the post-test academic achievements mean scores of students taught Basic Technology (BTE) with MLS and those taught with DIS

2 There is no significant difference between the post-test academic achievement mean score of BTE students exposed to pre-test/post- test and those exposed to post- test only using MLS

3. Pre-testing and instructional strategy (MLS) do not have significant interaction effects on students' academic achievement mean scores in Basic Technology

IV. METHODOLOGY

Quasi-Experimental design was adopted in this study. Specifically, Solomon four non equivalent group design model was used. The population was 3,170 (1,675 male and 1,495 female) JSS II students' 119 (66 male, 53 female) JSS11 students from four selected mixed schools participated in this study. Stratified sampling technique was used. A 50-item four options multiple choice Basic Technology Achievement Test (BTEAT) was used. The instrument was face and content validated by four experts before administration. Test – retest method was used to establish the reliability of the instrument. Pearson product moment correlation coefficient was used to correlate the two results and a reliability index of 0.85 was obtained. Experimental group E_1 and control group C_1 received BTEAT pre-test before commencement of the treatment, thereafter all the groups received post-test. Data collected were analyzed with descriptive and inferential statistics (mean, mean difference, t-test and Analysis of Covariance (ANCOVA). The statistical package for social sciences (SPSS) was used.

Results

Research Question 1

What are the pre-test and post-test academic achievement mean scores of students taught Basic Technology (BTE) with Direct Instruction Strategy (DIS) and those taught with Mastery Learning Strategy (MLS)?

The data related to this research question are presented in Table 1

Table 1: Pre-Test and Post-Test Academic Achievement Mean Scores of Students taught Basic Technology with Direct Instruction Strategy (DIS) and those taught with Mastery Learning Strategy (MLS)

Instructional strategy	N	Pre-Test mean	Post-Test mean
Direct Instruction Strategy (DIS)	40	49.64	51.61
Mastery Learning Strategy (MLS)	38	51.13	66.97

Data in Table1 showed that the pre-test and post test academic achievement mean scores of the control group (DIS) were 49.64 and 51.61 respectively. For the experimental group (MLS) pre-test and post test academic achievement mean scores were 51.13 and 66.97 respectively. Results showed that post test academic achievement mean scores were higher than the pre-test academic achievement mean scores.

Research Question 2

What are the post test academic achievement mean scores of students taught BTE using Mastery Learning Strategy without pre-test?

The data related to this research question are presented in Table 2.

Table 2 Academic Achievement Mean Scores of Students Taught BTE Using Mastery Learning Strategy but Exposed to Post-test only

Group	N	Post Test Mean score
E_2(MLS) post test only	41	65. 09

Data in Table 2 showed the academic achievement mean scores of experimental group E_2; the post test mean score was 65.09.

Research question 3

What is the difference between post-test academic achievements mean Scores of students taught basic technology with MLS and those taught with DIS?

The data related to this research question are presented in Table 3.

Table 3 Post-test Academic Achievements Mean Scores difference of Students Taught Basic Technology (BTE) with MLS and those Taught with DIS

Instructional Strategy	N	Post- Test mean scores	Post Test mean score diff.
Mastery Learning Strategy	38	66.97	
Direct Instruction Strategy	40	51.61	15.36

Data in Table 3 showed that post-test academic mean scores of BTE students taught with MLS was 66.97, while those taught with DIS was 51.61. The post test academic means score difference was 15.36, meaning the post test mean score of BTE students taught with MLS was higher than those taught with DIS.

Research Question 4

What is the difference between post-test academic achievement mean score of students taught BTE with MLS exposed to pre-test/post-test and those exposed to post-test only?

Data related to this research question are presented in Table 4.

Table 4 Post-test Academic Achievement Mean Score of Students taught BTE using MLS Exposed to Pre-test/Post-test and those Exposed to Post-test only

Groups	N	Pre-Test Mean score	Post-Test Mean score	Post test Mean score difference.
E_1[pre-test & post-test]	38	51.13	66.97	1.88
E_2[post-test only]	41	-	65.09	

Table 4 showed that achievement mean scores of experimental groups E_1 and E_2 in their post-test mean scores were 66.97 and 65.09 respectively. The post test mean score difference of 1.88, revealed that students taught BTE with MLS, exposed to pre-test/post-test performed slightly higher than those exposed to post-test only.

I. STATISTICAL RESULTS OF NULL HYPOTHESES

The three null hypotheses formulated were tested in this section. Analysis of Covariance (ANCOVA) statistic was used for analyzing data relating to all the seven hypotheses. The hypotheses were tested at 0.05 level of significance.

Null Hypothesis 1

There is no significant difference between the post-test academic achievement mean scores of students taught BTE with MLS and those taught with DIS.

The data related to this hypothesis are presented in Table 5.

Table 5 ANCOVA Result Summary of Differences between the Post-test Academic Achievement Scores of Students Taught BTE with MLS and those Taught with DIS

Dependent Variable: Post-Test

source	Sum of square	df	Mean square	F	P-value	Decision
Instructional strategy	7754.585	1	7754.585	173.922	.000	Significant

Data in Table 5 showed that at 0.05 level of significance the ANCOVA result ($F_{.}$ = 173.922 df =1; P<0.05) revealed a significant difference. Therefore the null hypothesis that there is no significant difference between the post-test academic achievement mean scores of students taught Basic Technology with MLS and those taught with DIS was rejected. This implies that MLS significantly improved the students' post-test academic achievement in BTE.

Null Hypothesis 2

There is no significant difference between the post-test academic achievement mean score of Basic Technology (BTE) students exposed to pre-test post- test and those exposed to post- test only using MLS.

The data related to this hypothesis are presented in Table 6.

Table 6 t-test summary of Difference between the Post-test Academic Achievements Mean Score of BTE Students Exposed to Pre-test/Post-test and those Exposed to Post-test only Using MLS

Experimental Groups (MLS)	Mean	SD	Mean Diff.	$t_{cal.}$ valu	P-. value	Decision
E_1 [pre-test/post-tests]	66.97	10.85	1.88	1.154	0.05	Not significant
E_2 [post-test only]	65.09	9.58				

Data in Table 6 show that at 0.05 level of significance the t-test result (t_{cal} = 1.154 df =2; P>0.05) revealed a not significant difference in the post test academic achievement mean score of group E_1&E_2 using MLS. Since the calculated $t_{cal.}$value of 1.154 is less than the criterion P-value. Therefore, at 0.05 the null hypothesis that there is no significant difference between the post-test academic achievements means score of Basic Technology (BTE) students exposed to pre-test/post- test and those exposed to post- test only using MLS was accepted. Meaning, even though there was difference it was not significant.

Null Hypothesis 3

Pre-testing and instructional strategy (MLS) do not have significant interaction effects on students' academic achievement mean scores in basic technology (BTE).

The data related to this hypothesis are presented in Table 7

Table 7ANCOVA Summary of Result on Pre-testing and Instructional Strategy (MLS) Interaction Effects on Students' Academic Achievement Scores in Basic Technology

Source	Sum of Squares	df	Mean Square	F	P-value	Decision
Pre-testing/Instructional Strategy (MLS)	8278.712	1	8278.712	261.215	.000	Significant

a. R Squared = .806 (Adjusted R Squared = .795)

Data in Table 12 show that ANCOVA result on the interaction between pre-testing and instructional strategy (MLS) on students academic achievement in BTE, was significant with (F=261.215; df = 1; P <0.05). Therefore the null hypothesis that pre-testing and instructional strategy do not have significant interaction effects on students' academic achievement mean scores in Basic Technology was rejected. This implies that the interaction effect of pre-testing and instructional strategy was significant.

V. DISCUSSION OF FINDINGS

The discussions of the results are based on the research questions that guided the study and null hypotheses formulated and tested at 0.05 level of significance.

Pre-testing, Instructional Strategies and Students Academic Achievement in Basic Technology

Analysis of data in Table 1, revealed that there was improvement in the post test mean scores of both the control group and the experimental group, though it was marginal in

control group. The researcher noted that exposing students to pre-test enhances their post-test academic achievements irrespective of the instructional strategy adopted. These findings further supported Nwoke, Uzoma, and Akukwe (2014), study which equally confirmed the benefit of allowing students to attempt tests more than once in order to improve their school academic achievement. Also the findings also agree with Ahmad and Aufan (2011), report on the effectiveness of pre-test exposure on students academic achievement and that it reinforces students understanding of the contents of the subject and strengthens his/her memory recall. They also noted that for such tests to be effective there is need for the students to be re-taught and have areas not clearly understood explained to them. These findings thus confirmed the importance of conducting pre-test on students' before treatment.

Furthermore, it was also noted that the differences in the academic achievements of experimental groups E_1 (exposed pre- test/post-test) and E_2 (exposed to post-test only) taught using MLS was not significant. This probably indicates that MLS reduces the effectiveness of pre-test on students' post test academic achievement in BTE. These findings confirmed Adeyemo and Babajide (2014), report that MLS has positive effect on students' academic achievement and also that pre-test assessment can have positive influence on the post-test achievement of students.

In addition, ANCOVA result on the interaction effect between pre-testing and instructional strategy (MLS) on BTE students academic achievement, was significant with ($F = 261.215$; $df = 1$; $P < 0.05$). Therefore the null hypothesis that pre-testing and instructional strategy do not have significant interaction effects on students' academic achievement mean scores in Basic Technology was rejected. This result further confirmed the findings of Nwoke, Uzoma, and Akukwe (2014**),** who reported that students with minimal prior knowledge of material have higher achievement through mastery learning strategy.

Mastery Learning Strategy and Students Academic Achievement in Basic Technology

Analysis on Table 3 results revealed that Mastery Learning Strategy enhances JSS II students' academic achievement in BTE with a mean score difference of 15.36 over the DIS. The ANCOVA results revealed a significant effect of MLS on students' academic achievement in BTE over DIS. This result agreed with the findings of Wambugu and Changeiywo (2008), who found that MLS facilitates students learning higher than the conventional strategy in Physics. It equally supported Adeyemo and Babajide (2014)**,** report that MLA resulted in higher student achievement than the regular teaching strategy in Agriculture. These results indicate that MLS possess certain attributes that makes it a superior teaching and learning strategy to the conventional teaching strategy, such attributes include use of formative and corrective assessment as an instructional tool, variation of time and instructional strategies. These findings further confirmed Ihendinihu (2013), who reported that Mastery Learning Approach enhances students' achievement in Mathematics and bridges the gap between students with high and low abilities learners in Mathematics. The finding also agrees with that of Abakpa and Iji (2011), who reported that mastery learning approach improved students' achievement in geometry, as well as that of Udo and Udofia (2014) whose analysis showed that students taught using mastery learning strategy performed significantly higher than those taught using the traditional strategy.

VI. CONCLUSION

Based on the findings, it was concluded that MLS is an effective teaching and learning strategy that significantly enhance students' academic achievement, if carefully implement irrespective of the subjects.

A. Implications of the study

1. It implies that, if basic technology educators embrace mastery learning strategy in their classrooms, it would promote active participation of all students in the learning process and as well encourage their choice for further study in technology.
2. The study also provides empirical proof that pre-testing back-up with re-teaching improved students academic achievement. This implies that for educators to help learners resolve their learning difficulties, the use of formative assessment as instructional tool is required.
3. Furthermore, careful implementation of these major elements of mastery learning would assist educators in helping children manage their learning difficulties and learn excellently well. More importantly, for successful implementation there is need to train BTE teachers.

B. Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. The government of Nigeria should introduce Mastery Learning Strategy into secondary school classrooms.
2. There should be deliberate plans by both government and school administrators to develop secondary school teachers' capacity to utilize MLS as a teaching strategy.
3. Teachers should be encouraged to continuously expose students to pre-tests as a means to enhancing their academic achievement in final assessment.

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