# EXPERIENTIAL LEARNING STRATEGY AND STUDENTS' PERFORMANCE IN MATHEMATICS ON THE COGNITIVE DOMAIN OF BLOOMS' TAXONOMY IN RIVER STATE, NIGERIA

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**ABSTRACT**
*This study examined experiential learning strategy and students' performance in Mathematics on the cognitive domain of Bloom's Taxonomy. Two research questions and two hypotheses guided the study. Quasi-experimental design, specifically pretest, posttest non-control group design, was adopted for the study. The population of the study consisted of 13,040 SS2 Mathematics students from 14 public secondary schools in Obio-Akpor Local Government Area, Rivers State out of which, a sample of 78 was drawn from the schools using purposive sampling based on availability and access to adequate facilities for Mathematics teaching and learning. Random sampling was used to select the intact classes for the study. The experimental groups were taught using the experiential learning strategy and while the control group was taught using the lecture teaching method. Mathematics Performance Test (MPT) was used for data collection. A reliability Coefficient of 0.79 was obtained for the instrument using Kudar Richardson 21. Research questions were answered using mean and standard deviation while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Findings of the study revealed that students taught Mathematics using experiential learning strategies performed better than their counterparts taught with the lecture teaching method at the comprehension and application level. The study recommends among others that the lecture*

*teaching method of teaching should be adopted to the use of an experiential learning strategy so as to improve the mathematics performance of students at both comprehension and application levels.*

**Keywords:** Experiential learning strategy, students` performance, cognitive domain, Bloom's Taxonomy.

## Introduction

Mathematics is the study of associations between numbers, shapes, and quantities. Mathematics is a way of life that allows learners to organize experiences and use them in life endeavors and society. Mathematics gets widely regarded as one of the important subjects for entry into most careers or when intending to get further training. Tshabalala and Ncube (2016) stated that Mathematics is the substratum and a crucial tool for scientific technological and economic for any nation to advance. The importance of mathematics and its role in national development cannot be overemphasized. The knowledge of mathematics gives students practical and valuable life skill which is appropriate and pertinent to numerous human activities and profession. Despite the highly decorated and recognized importance of mathematics and the fact that it is the prerequisite for most of the subjects, poor achievement and lack of interest in mathematics (and STEM) among students remains as an issue of concern in schools, colleges, and universities in developed and developing countries alike (Brown et al., 2020). Mathematics continues to be one of the most challenging subjects in schools as perceived by students (Akhter & Akhter, 2018).

A lot of factors have been attributed to the underachievement of students in Mathematics and the one that is most mutual is poor teaching methods. The challenge in learning mathematics is that the teachers are not adequately prepared to teach the students using suitable learning strategies. Adegoke (2010) observed that the conventional lecture strategy is usually the dominant approach used by teachers in Nigeria and students are not actively tangled in fashioning their knowledge; they generally remain passive listeners throughout the lesson. Hence, the strategy is mainly a teacher-centered approach to learning Mathematics and learners are mainly inactive in the teaching and learning process. In view of the lapses inherent in the conventional lecture strategy of teaching Mathematics and subsequent low achievement by students in the subject, mathematics educators are continually making efforts towards finding ways of improving students' performance in Mathematics. The concept of the thinking process in learning Mathematics has a direct bearing on Benjamin Bloom's Taxonomy.

Bloom's taxonomy is a six-tiered approach to intellectual expectations of Mathematics assessment. Bloom's taxonomy is organized as follows: knowledge, comprehension, application, analysis, evaluation, and synthesis. Mathematics questions asked by teachers have been found to focus mainly on lower-order tasks. Numerous studies have used Bloom's taxonomy as the standard for judging whether test items are Lower-order thinking (LOT) or higher-order thinking (HOT) (Jansen &Möller, 2022; Tsaparlis, 2020). According to Saido, Siraj, Nordin and Al_Amedy (2018), the thinking skills in Bloom's taxonomy are considered Lower-order thinking (LOT) including knowledge and comprehension, while the thinking skills of analysis, synthesis, and evaluation are

considered higher-order thinking (HOT). Samo (2016) revealed that higher-order thinking is a type of non-algorithm thinking which include analytic, evaluative, and creative thinking that involves metacognition. However, lower-order thinking (LOT) is often characterized by the recall of information or the application of concepts or knowledge to familiar situations and contexts.

Lower-order thinking (LOT) tasks require a student to recall a fact, perform a simple operation in Mathematics, or solve a familiar type of problem. It does not require the student to work outside the familiar. Senk, Beckman, & Thompson (1997) categorized Lower-order thinking (LOT) as cracking tasks where the result necessitates smearing a well-known procedure, often with no validation, clarification, or proof required, and where only a solitary right answer is conceivable. In general, Lower-order thinking (LOT) is generally characterized as solving tasks while working in familiar situations and contexts; or, applying algorithms already familiar to the student. Lower-order thinking (LOT) is considered to be core and very important as it helps the students develop their line of thought, acquire knowledge on different topics and apply the knowledge effectively. Based on the description a2bove, it can be said that it is also important to evaluate students' Lower-order thinking (LOT) Mathematics performance in order to determine the extent of students' Lower-order thinking (LOT) in the Mathematics learning process. Accordingly, the purpose of the study is to as well as whether there is any difference between levels of student's comprehension and application level of mathematics performance via the Experiential learning strategy

Experiential learning is the way toward learning through understanding and is all the more explicitly characterized as "learning through reflection on doing (Jeyaraj, 2019). Experiential learning strategy is a strategy in which Mathematics purposefully engage with student in direct experience and focused reflection in order to increase knowledge, develop skills, and clarify values. Experiential learning is also referred to as learning through action, learning by doing, and learning through discovery, and exploration. Experiential learning requires self-initiative, an "intention to learn", and an "active phase of learning (Shi et al., 2020). The benefits of experiential learning as it relates to student learning outcomes in Mathematics provide students with opportunities to have hands-on experiences to aid them in learning abstract mathematics concepts. Edward and Samba, (2020) investigated the effects of graphic organizers and experiential learning with feedback on students' achievement and retention in Basic Science and Technology, Plateau State., Nigeria. The findings revealed that there were significant differences in both graphic organizer and experiential learning achievement.

Also, Chesimet, Githua and Ng'eno, (2016) investigated the Effects of the Experiential Learning Approach on students' mathematical creativity in Kericho East Sub-County. The results revealed that Experiential Learning Approach had a significant effect on students' mathematical creativity. A similar study by Adeniyi and Kuku (2020) showed that achievement in Mathematics differs as a result of exposing learners with hearing impairment to gamification and experiential learning methods of instruction. Anees (2017) examined the assessment levels of students' learning according to the cognitive domain of

Bloom's Taxonomy. The results showed that there were more focused on lower levels of learning while asking questions. There was less implementation of higher-level of questions. Prasad (2020) also carried out a study on student performance based on bloom's taxonomy levels, knowledge, comprehension, application, analysis, synthesis, and evaluation. The result showed that there are few students whose performance is excellent at the first two levels, average at the third level, and poor at the fourth, fifth, and sixth levels. Farzad and Hassan (2010) studied students' mathematical performance based on the cognitive dimension of the Revised Bloom Taxonomy (RBT) and revealed that there was a difference between students' mathematical performance in each category of knowledge dimension according to the cognitive process of the Revised Bloom Taxonomy and students' mathematical performance would be decreased from remembering through creating in each category of knowledge dimensions.

Research studies have shown that experiential learning strategies improve the mathematical creativity of students, enhance the performance of students in Basic technology, and also improved the mathematics achievement of students with hearing impairment. Also, a study has been carried out by Prasad (2021) on student performance based on bloom's taxonomy levels, knowledge, comprehension, application, analysis, synthesis, and evaluation, students' mathematical performance based upon the cognitive dimension of Revised Bloom Taxonomy (RBT), and students' learning according to the cognitive domain of Blooms' Taxonomy. However, the present study focused on Experiential learning strategies on students' performance in Mathematics at the comprehension and application level.

**Statement of the Problem**

The difficulty in identifying the suitable method of teaching Mathematics has continued to be of great concern to Mathematics teachers as well as the need for improvement in academic achievement of students for the realization of the instructional objectives in teaching and learning of Mathematics. Mathematics is an important subject required to pursue careers that demand logical, investigative, critical, and analytical skills. This is because learning Mathematics gives a student an opportunity to make lasting contributions to society in diverse fields of his or her endeavor. Research has revealed that successful Mathematics learning is dependent on the teachers' ability to adopt the most suitable instructional strategy in the delivery of the Mathematics content to enhance the student's performance at the comprehension and application level. This has brought about some innovative measures that can help bring about the notion of improving performance level of students in Mathematics but the extent to which these measures are efficient in actualizing high performance level of students in Mathematics. Hence this study seeks to determine if experiential learning strategy can affect students' performance in Mathematics on the cognitive domain of Bloom's Taxonomy.

**Purpose of the Study**

The purpose of the study was to investigate experiential learning strategy and students' pe2rformance in M2athematicson the cognitive domain of Bloom's Taxonomy.

Specifically, the study seeks to determine:

1) the effect of Experiential Learning strategy and lecture method on students' performance in Mathematics at the comprehension level.
2) the effect of Experiential Learning strategy and lecture method on students' performance in Mathematics at the application level

**Research Questions**

The study answered the following questions:

1) What is the effect of Experiential learning strategy and lecture method on students' performance in Mathematics at the comprehension level?
2) What is the effect of Experiential learning strategy and lecture method on students' performance in Mathematics at the application level?

**Hypotheses**

The following null hypotheses were tested at a 0.05 level of significance:

1. There is no significant difference between students exposed to the experiential learning strategy and the lecture method in their performance in Mathematics at the comprehension level.
2. There is no significant difference between students exposed to experiential learning and the Lecture method in their performance in Mathematics at the application level.

**Methods**

**Research Design**

This study employed a quasi-experimental design. Specifically pretest, posttest non-control group design. Intact classes were then used for the study. Subjects were not randomly assigned to groups rather intact classes were assigned to experimental and control groups. A pre-test was administered to both the experimental group and control group to determine if any difference exists in the ability of the two groups before treatment. The experimental group received treatments after which a post-test was administered to both groups their after.

**Population of the Study**

The population of the study consists of 13,040 SS2 Mathematics students in fourteen (14) senior secondary schools in Obio-Akpor Local Government Area of River State.

**Sample and Sampling Technique**

The sample of the study consists of 78 mathematics students in the fourteen senior secondary schools. The sample for this study was obtained using purposive sampling technique, which was used to select two public secondary schools based on availability and access to adequate facilities for Mathematics teaching and learning. The selected schools also have Mathematics laboratories that were needed for the effective completion of this study. Random sampling technique was used to select the intact classes for the study but was not used to assign students to the control and experimental groups.

**Instrument for Data Collection**

Mathematics Achievement Test (MAT)was used for data collection. The MAT is a 20-item, 4 options multiple choice objective test based on the content of the study in the SS2 Mathematics curriculum.

**Validity of Instrument**

The instrument was validated by two experts, one lecturer in measurement and evaluation and one in science education, all in the faculty of Education, University of Port Harcourt, Choba. The experts were asked to validate the instrument in terms of clarity of instructions; correct wording of items, and appropriateness and adequacy of the items in addressing the aim of the study. The critical appraisal and comments of the experts were used.

**Reliability of the Instrument**

The student's responses in the MAT were used to obtain the reliability coefficient using Kudder Richardson's formula 21 (K-R21) procedures. The reliability coefficient for the MAT was 0.89

**Methods of Data Analysis**

Data collected was analyzed using mean and standard deviations to answer the research questions while Analysis of Covariance (ANCOVA) was used in testing the hypotheses at a 0.05 level of significance.

**Results**

**Research Question 1:** What is the effect of Experiential learning strategy and lecture teaching method on students' performance in Mathematics at comprehension level?

**Table 1: Performance mean scores of the comprehension level of Mathematics based on strategy**

| | Comprehension level | | | | | |
|---|---|---|---|---|---|---|
| **Strategies** | | **Pretest** | | **Posttest** | | |
| | n | Mean | Std | Mean | Std | Gain |
| Lecture | 48 | 10.10 | 2.41 | 9.29 | 3.29 | -0.81 |
| Experiential | 30 | 10.73 | 2.08 | 13.60 | 2.13 | 2.87 |

Table 1 indicates that in the comprehension level of Mathematics, students exposed to lecture teaching method had a mean gain of -081, while the students exposed to experiential learning strategy had a mean gain of 2.87. Summarily, at comprehension level, students exposed to experiential learning strategy performed better than their counterparts who were taught Mathematics with lecture teaching method.

**Research Question 2:** What is the effect of experiential learning and lecture teaching method on students' performance in Mathematics at application level?

**Table 2: Performance mean scores of the Application level of Mathematics based on strategy**

| Strategies | Application Level | | | | | |
|---|---|---|---|---|---|---|
| | Pretest | | | Posttest | | |
| | n | Mean | Std | Mean | Std | Gain |
| Lecture | 48 | 5.70 | 2.50 | 6.43 | 3.35 | 0.73 |
| Experiential | 30 | 5.80 | 1.98 | 11.93 | 3.358 | 6.13 |

Table 2 indicates that at the Application level of Mathematics, students exposed to the lecture teaching method had a mean gain of 0.73, while the students exposed to the experiential learning strategy had a mean gain of 6.13. Summarily, at the Application level, students exposed to experiential learning strategy performed better than their counterparts who were taught Mathematics with a lecture teaching method.

**Hypothesis 1:** There is no significant difference between students exposed to Experiential learning strategy and lecture teaching method in their performance in Mathematics at the comprehension level.

**Table 4: Analysis of Covariance of students' Comprehension level of Mathematics based on learning strategies**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 349.295[a] | 2 | 174.648 | 20.644 | .000 | .355 |
| Intercept | 356.834 | 1 | 356.834 | 42.179 | .000 | .360 |
| Pretest Comprehension | 6.617 | 1 | 6.617 | .782 | .379 | .010 |
| Groups | 323.957 | 1 | 323.957 | 38.293 | .000 | .338 |
| Error | 634.499 | 75 | 8.460 | | | |
| Total | 10334.000 | 78 | | | | |
| Corrected Total | 983.795 | 77 | | | | |

Analysis of Covariance (ANCOVA) was conducted to determine if a significant difference exists in the comprehension level of students' performance in Mathematics when exposed to lecture teaching method and experiential learning strategy. Table 3 revealed that $F(1,75) = 38.293$, $p < 0.05$, since the p-value of 0.00 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant difference in the comprehension of students' performance in Mathematics when exposed to lecture teaching group and experiential learning strategy group.

**Hypothesis 2:** There is no significant difference between students exposed to Experiential learning strategy and lecture teaching method in their performance in Mathematics at the application level.

**Table 4: Analysis of Covariance of students' Application level of Mathematics based on instructional methods**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 560.078[a] | 2 | 280.039 | 23.357 | .000 | .384 |
| Intercept | 807.660 | 1 | 807.660 | 67.364 | .000 | .473 |
| Application | 2.463 | 1 | 2.463 | .205 | .652 | .003 |
| Groups | 555.962 | 1 | 555.962 | 46.371 | .000 | .382 |
| Error | 899.217 | 75 | 11.990 | | | |
| Total | 7163.000 | 78 | | | | |
| Corrected Total | 1459.295 | 77 | | | | |

Analysis of Covariance (ANCOVA) was conducted to determine if a significant difference exists in the application level of students' performance in Mathematics when exposed to a lecture group and an experiential learning strategy group. Table 3 revealed that $F(1,75) = 46.371$, $p < 0.05$, since the p-value of 0.00 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant difference in the application level of students' performance in Mathematics when exposed to lecture group and experiential learning strategy group.

**Discussion**

The findings of the study revealed the mean gain scores of students at the comprehension level who were taught Mathematics using experiential learning yielded a higher mean score than those taught using the lecture teaching method. The finding affirmed the study of Edward and Samba, (2020) who investigated the effects of graphic organizers and experiential learning with feedback on students' achievement and retention in Basic Science and Technology. The findings revealed that there were significant differences in both graphic organizer and experiential learning achievement. Furthermore, the findings of Anees (2017) showed that there were more focused on lower levels of learning while asking questions. The results of the study indicate that the experiential learning strategy is useful to improve students' performance in Mathematics at the comprehension level. A possible reason for this result could be that the experiential class enjoyed the way they were taken outside the classroom to the mathematics laboratory to find out things for themselves and were also allowed to share their experiences with one another.

The findings of the study also revealed that the mean gain scores of students who were taught Mathematics using experiential learning strategy at the application level are higher than the mean gain scores of the students who were taught lecture method. Table 4 confirmed that the difference between the experiential instructional learning strategy and lecture teaching method was significant. This improvement in the performance of the students can be attributed to the fact that students were learning through action, learning by doing, learning through discovery and exploration was a propelling force that helps students in paying attention as well as keeping students involved and active in Mathematics classroom activities. The findings of this study support the findings of Chesimet et al

(2016) who revealed that the Experiential Learning Approach had a significant effect on students' mathematical creativity. Also, in consonance with Prasad (2020) who carried out a study on student performance based on bloom's taxonomy levels, knowledge, comprehension, application, analysis, synthesis, and evaluation. The result showed that there are few students whose performance is excellent at the first two levels, average at the third level, and poor at the fourth, fifth, and sixth levels.

## Conclusion

The study established that experiential learning strategies can be used to enhance the mathematics performance of students at the comprehension and application levels. Furthermore, it also can be concluded that there is a difference between students' performance in Mathematics in comprehension and application level when exposed to experiential learning strategies and lecture teaching methods in favour of experiential learning strategies.

## Recommendations

Based on the findings of this study, it was recommended that:

1. The lecture teaching method of teaching should be adopted to the use of an experiential learning strategy so as to improve the mathematics performance of students at both comprehension and application levels.
2. For practical implementation of expe8riential learning strategy, it is necessary that government provides the necessary infrastructure like mathematics laboratories for public schools in Rivers state.
3. Teachers should be provided the necessary training to use experiential learning strategy. In this, the academic performance of high achievers and low achievers will be enhanced.
4. Interactive and practical-oriented instructional methods like experiential learning strategy should be preferably used in teaching mathematical concepts.

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