

EFFECTS OF EXPERIENTIAL AND ACTION LEARNING STRATEGIES ON SENIOR SECONDARY SCHOOL STUDENTS' LEARNING OUTCOMES IN MATHEMATICS IN OSUN STATE, NIGERIA

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Abstract

Mathematics classroom becomes more meaningful and appealing to students' interest when teaching learning processes help participants to study their own actions and experience in order to perform well in Mathematics. In this awareness, this paper research into the effects of experiential and action learning strategies on senior secondary school students' learning outcomes in mathematics in Osun state, Nigeria. This study employed a quasi-experimental of pre-test, post-test, control group design, using 3x2x2 non randomized factorial design. The sample for the study was 300 Senior Secondary School II (SSSII) students selected from six high schools in Osun State using multistage sampling procedure. The experimental procedure was carried out in three stages namely: the pre-treatment stage (one week), the treatment stage (four weeks) and post-treatment stage (one week). Six weeks altogether was used for the whole study. The data collected for the study were subjected to descriptive statistics using mean and standard deviation as well as inferential statistics of Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA). Multiple Classification Analysis (MCA) was also used to locate where the difference had occurred. The study found that the use of experiential and action learning strategies enhanced better academic performance of secondary school students in Mathematics than the conventional method. Both experiential and action learning strategies are potent drive for positive attitude towards Mathematics. However, students exposed to experiential learning reported slightly high level of academic performance while those exposed to action learning had slightly highest adjusted mean scores on attitude towards Mathematics. Hence, it was recommended that the potential of experiential and action learning strategies should be maximize in the teaching of Mathematics to enhance better achievement of students in Mathematics.

Introduction

Mathematics, because of its widest and essential applications in day to day activities of individuals, governmental and non-governmental organisations has occupied a central stage in the global research and education curriculum. In Nigeria education curriculum and policy, the role of Mathematics as one of the core subjects in secondary school which any student seeking admission into tertiary institution must

passed, cannot be over-emphasis. Mathematics formed the bedrock of information communication and technology which today bring the world to the view of common man, setting no barrier to cultural and geographical diversity. Therefore, it is critical to note according to Popoola, (2014) who described Mathematics as a science of numbers and shapes, that no nation can hope to achieve any measure of scientific and technological advancement without

proper foundation in the school Mathematics. She further reiterated that Mathematics is the basis for scientific theories and experiment used in everyday life to solve personal and societal problems.

Despite the value and usefulness of Mathematics to the individual, society and the government alike, the performance of students in senior secondary school in Nigeria has remained an issue of concern to all stake holders (Salman, Mohammed, Ogunlade and Ayinla, 2012). Rachna, (2010) and Popoola,(2014) at different times saw Mathematics as important and therefore occupied a central position since the ancient period, yet, students do not find Mathematics interesting; they reiterated that the gaps are found between aspiration and achievement. They also added that Mathematics is perceived as highly abstract which is concerned with ideas rather than objects; with the manipulation of symbols rather than the manipulation of object.

The sources of problem associated with poor performance in Mathematics as identified by researchers such as Popoola and Akinsola (2004), Popoola (2009) and Kolawole (2010) in different studies included the use of Lecture method. They describe lecture method as being monotonous and teacher centred. Lecture Method of teaching is the oldest teaching method applied in educational institution this claimed that it has been in existing since middle age. The teaching method is one way channel of communication of information. Students' involvement in this teaching method is just to listen and sometimes pen down some note if necessary during the lecture, combine the information and organize it. One of the problems in this method is to grab the attention of students in the classroom. This method, though is an old

method of teaching, it has the advantage of teaching large number of students which requires no instructional material.

From the researcher's experience as a teacher of Mathematics, the content of Mathematics curriculum indicates that innovation is required in the teaching process to promote efficient learning. There is the need for the use of teaching strategies that will not only provide meaningful understanding of concepts in Mathematics but also provide students the opportunity to play active role in teaching and learning process. Thus this paper is set to examine the effects of experiential and action learning strategies on students' learning outcome in Mathematics in Osun State, Nigeria.

Research Hypotheses

The following research hypotheses were postulated for the study:

- 1 There is no significant difference in the performance mean scores of students in the experimental and control groups before treatment.
- 2 There is no significant difference in the attitudinal mean scores of students in experimental and control groups before treatment.
- 3 There is no significant difference in the performance mean scores of students in the experimental and control groups after treatment.
- 4 There is no significant difference in the attitudinal mean scores of students in the experimental and control groups after treatment.

Literature Review

1. Experiential Learning Strategies and Students Learning Outcome in Mathematics

According to Association for Experiential Education (2011), experiential learning (EL) is

a philosophy and methodology in which educators purposefully engage with students in direct experience and focused reflection in order to increase knowledge, develop skills, and clarify values. By implication, it involves the process through which students develop knowledge, skill and value from direct experience outside a traditional academic setting.

Experiential Learning encompasses of varieties of activities including internships, service learning, undergraduate research, study abroad and other creative and professional work experience. Well planned supervised and assessed Experiential Learning programs could stimulate academic inquiry by promoting interdisciplinary learning, civic engagement, career development, cultural awareness, leadership and other professional and intellectual skills. In the word of Ebonyi (2013) experiential learning is characterized by students' active participation in the learning process such that learning becomes interactive, participatory, cooperative and collaborative. Such classroom provides opportunities for students to discover and gain firsthand knowledge through observation and experimentation rather than learning or reading about other people experience.

The focus of Experiential Learning is placed on the process of learning and not the product of learning. Proponents of Experiential Learning assert that students are more motivated to learn when they have a personal stake in the teaching process rather than being assigned to review a topic or read a text book chapter. Experiential Learning teaches students the competencies they need for real- world success. It is the desire of the public that education teaches students the competencies they need for

real-world success. Experiential Learning creates an invaluable opportunity to prepare students for profession or carrier. Thus Sullivan and Rosin (2008) argue that the mission for higher education is to bridge the gap between theory and practice. Bass (2012) therefore suggests that the educational environment need to intentionally create rich connection between the formal and experiential curriculum.

Experiential learning provides the conclusion for optimally supporting student's learning. It is when students are engaged in learning experiences that they see its relevance they have increase motivation to learn. Students are also motivated when they are provided opportunities for practice and feedback. Therefore, experiential learning approach integrates academic content and peer partnership (Goldberg, 2007) which is designed to increase students' understanding of the concepts and ideas in a particular subject (Goldberg & Coufal, 2009).

2. Action Learning Strategy and students' learning outcome in Mathematics

Action learning is a method and strategy that is very useful and student oriented method of instruction. Mumford (1996) described Action Learning as a dynamic process that involves a small group of people solving real problems, while at the same time focusing on what they are learning and how their learning can benefit each group members, the group itself and the organization as a whole. Afolabi (2010) described action learning as an educational process whereby participants study their own actions and experience in order to perform well in Mathematics. This is done in conjunction with others in small groups called action learning set. The foregoing projects that, action learning is based on the

idea that learning is a naturally social act in which the participants talk and manipulate objects among themselves. It is through the talk and hands-on that learning occurs.

Research Methodology

This study employed a quasi-experimental of pre-test, post-test, control group design, using 3x2x2 non randomized factorial design. The sample for the study was 300 Senior Secondary School II (SSSII) students selected from six high schools in Osun State using multistage sampling procedure. Two instruments titled 'Mathematics Performance Test (MPT)' and 'Students' Attitudinal Questionnaire towards Mathematics (SAQTM)' were used for the study. Mathematics Performance Test (MPT) constituted the pre-test and post-test instruments for the students which consisted of two sections. Section A was use to retrieve bio-data information of the respondents such as name of school, class, sex, age and school location. Section B consisted of a multiple choice question drawn from topics in the curriculum of SSII as at the time of experiment. The topics from which the questions were drawn are: Number and Numeration, Geometry, and Set theory. The second instrument 'Students' Attitudinal Questionnaire towards Mathematics (SAQTM)' also consisted of two section A and B. Section A elicited demographic information of the respondent such as; name of school, sex, age, and local government area, while section B was 25

attitudinal item worded in a 4-point Likert type rating scale ranging from Strongly Agree (SA) =4, Agree (A) =3, Disagree (D) =2 and Strongly Disagree (SD) =1. Face and content validity of the instruments was ensure with the help of the researcher's supervisor, expert in Tests and Measurement as well as two experienced Mathematics educators in the Department of Science Education, Ekiti State University. The reliability of MAT and SAQTM was determined through test retest method of testing reliability. Reliability coefficients of 0.92 and 0.90 for MAT and SAQTM were obtained respectively. The experimental procedure was carried out in three stages namely: the pre-treatment stage (one week), the treatment stage (four weeks) and post-treatment stage (one week). Six weeks altogether was used for the whole study. The data collected for the study were subjected to descriptive statistics using mean and standard deviation as well as inferential statistics of Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA). Multiple Classification Analysis (MCA) was also used to locate where the difference had occurred.

Results

Hypothesis 1: There is no significant difference in the performance mean scores of students in the experimental and control groups before treatment.

Table 1: ANOVA of Students' Performance in Mathematics Scores before Treatment

Source	SS	df	MS	F	P
Between Groups	177.552	2	88.776		
Within Groups	10997.578	305	36.058	2.462	0.087
Total	11175.130	307			

p>0.05

The result in table 1 showed that $F_{2,305} = 2.462$. $P > 0.05$. There is no significant difference in the performance mean scores of students in experimental and control groups before treatment; hence the null hypothesis was not rejected. This shows the

homogeneity of performance of the three groups at the beginning of the study.

Hypothesis 2: There is no significant difference in the attitudinal mean scores of students in the experimental and control groups before treatment.

Table 2: ANOVA of Students' Attitudes' Towards Mathematics before Treatment

Source	SS	df	MS	F	P
Between Groups	261.324	2	130.662		
Within Groups	29444.896	305	96.541	1.353	0.260
Total	29706.221	307			

$p > 0.05$

The result in table 2 showed that $F(1.353) > P$ value at 0.05 level of significance. Therefore the null hypothesis was not rejected. Hence there is no significant difference in the attitudinal scores of students in experimental and control groups before treatment. This shows the homogeneity of the attitude of

the three groups at the beginning of the study.

Hypothesis 3: There is no significant difference in the performance mean scores of students in the experimental and control groups after treatment.

Table 3: ANCOVA of Students' Performance in Mathematics in Experimental and Control groups after treatment

Source	SS	df	MS	F	P
Corrected Model	9985.918a	3	3328.639	82.101	.000
Covariate (Pretest)	895.417	1	895.417	22.086	.000
Group	9568.477	2	4784.239	118.004*	.000
Error	12325.079	304	40.543		
Total	673947.000	308			
Corrected Total	22310.997	307			

* $p < 0.05$

Table 3 show that there is significant difference in the performance scores of students in the experimental and control groups after treatment ($F_{2,304} = 118.004 > p, p < 0.05$). The null hypothesis was rejected.

In order to locate the sources of pairwise significant difference among the groups, Scheffe Posthoc test was carried out. The result is presented in table 4.

Table 4: Scheffe Posthoc Analysis of Students' Performance in Mathematics after Treatment

Learning Strategies	1	2	3	N	Mean
Experiential Learning (1)			*	101	50.50
Action Learning (2)			*	103	49.22
Control (3)				104	38.42

Table 4 showed that there was significant difference between the performance of students exposed to Experiential Learning and control groups at 0.05 level of significance. Similarly, the mean difference between Action Learning and control group is statistically significant at 0.05 level. However, there was no significant difference in the performance mean scores of students exposed to experiential learning strategy

and those taught using Action leaning strategies at 0.05 level of significance.

Multiple Classification Analysis (MCA) was used to determine the effectiveness of the treatment (Learning strategies) at enhancing students' achievement in Mathematics. The result is presented in table 5.

Table 5: Multiple Classification Analysis of students' achievement mean score by treatment

Grand Mean = 46.00					
Variable + Category	N	Unadjusted Devn'	Eta ²	Adjusted for Independent + Covariate	Beta
Experiential Learning	101	4.50		4.48	
Action Learning	103	3.22	.45	3.41	.14
Control	104	-7.58		-7.58	

MultipleR =0.137, Multiple R² =0.019

The result in table 5 showed that, with a grand means of 46.00; students exposed to Experiential Learning strategy had the highest adjusted mean score of 50.48 (46.00+4.48) in Mathematics, closely followed by those in the Action Learning strategy group; 49.41(46.00+3.41) while those in the control had the least adjusted mean score of 38.42 (46.00+(-7.58). It implies that the use of Experiential and Action Learning strategies constitutes

effective strategies for enhancing students' achievement in Mathematics. The treatment accounted for about 45% (Eta²= 0.445) of the observed variance in students' performance in Mathematics is largely due to the effectiveness of the treatment.

Hypothesis 4: There is no significant difference in the attitudinal means scores of students in the experimental and control groups after treatment.

Table 6: ANCOVA of Attitudinal Mean Scores of Students by Treatment

Source	SS	df	MS	F	P
Corrected Model	16312.292	3	5437.431	115.153	.000
Covariate (Pretest)	3830.755	1	3830.755	81.127	.000
Group	11505.129	2	5752.565	121.826*	.000
Error	14354.678	304	47.219		
Total	850137.000	308			
Corrected Total	30666.971	307			

*p<0.05 (Significant result)

Table 6 showed that there was a significant difference in the attitudinal scores of students in the experimental and control groups after treatment ($F_{2,304} = 121.826$, $p < 0.05$). Thus, the null hypothesis is rejected.

In order to locate the sources of pairwise significant difference in the attitudinal mean scores among the groups, ScheffePosthoc test was carried out. The result is presented in table 7.

Table 7: ScheffePosthoc Analysis of students' attitudinal mean scores by treatment

Learning Strategies	1	2	3	N	Mean
Experiential Learning (1)			*	101	55.14
Action Learning (2)			*	103	57.03
Control (3)				104	42.73

Table 7 revealed that there was significant difference between the attitudinal mean scores of students exposed to Experiential Learning strategy and control groups at 0.05 level of significance. Similarly, the mean difference between Action Learning and control group is statistically significant at 0.05 level.

Multiple Classification Analysis (MCA) was used to determine the effectiveness of the treatment (Learning strategies) at enhancing students' attitude towards Mathematics. The result is presented in table 8.

Table 8: Multiple Classification Analysis of students' attitude in Experimental and control groups

Grand Mean = 51.58					
Variable + Category	N	Unadjusted Devn'	Eta ²	Adjusted for Independent + Covariate	Beta
Experiential Learning	101	3.58		3.08	
Action Learning	103	5.45	.53	5.50	.40
Control	104	-8.85		-8.43	
Multiple R = 0.396, Multiple R ² = 0.157					

The result in table 8 showed that with grand mean of 51.58; students exposed to Action Learning strategy had the highest adjusted mean score of 57.08 ($51.58 + 5.50$) on attitude towards Mathematics, closely followed by those in the Experiential Learning group; ($51.58 + 3.08$) while the students in the control had the least

adjusted mean score of 43.15 ($51.58 + (-8.43)$). This implies that the use of Experiential and Action Learning strategies had the potency of enhancing students' attitude towards Mathematics. The treatment explained about 53% ($Eta^2 = 0.53$) of the observed variance in students' attitude towards Mathematics is largely due to the treatment.

Discussion

This study examined the effects of experiential and action learning strategies on senior secondary school students' learning outcomes in mathematics in Osun State. The findings of the study showed that performance and attitude of students toward mathematics were improved upon exposure to the treatment. The study showed homogeneity of the performance and attitude before the treatment. There was no significant difference in the pre-test of the performance and attitude scores of the students in experimental and control groups before treatment.

By implication, the background knowledge of students in Mathematics prior to the treatment in each of the three groups could be adjudged to be equal. Thus, any significant difference recorded later might not be due to chance other than the treatment applied. The researcher however, observed that the reason for the low Mathematics performance of students prior to their exposure to treatment might not be unconnected with ineffectiveness of traditional approach to teaching of Mathematics in Nigeria schools. This study conforms with the assertion of Eniayeju and Azuka (2010) who noted that over 90% of the teachers that attended the National Mathematical Centre workshops from 2002 to 2010 still use the traditional method of teaching. Thus, the authors lamented that the deteriorating students' performance in the subject clearly demonstrated the failure of the delivery system.

The study also confirmed that, the attitude of students in both experimental and control groups in pre-test were poor and do not differ statistically. Thus, explained uniformity in students attitude to Mathematics before their exposure to

experiential and action learning strategies. Consequently, the attitude of students towards Mathematics prior to the treatment in each of the three groups could be adjudged to be equal. However, any significant differences observed thereafter might not be due to chance, but a direct implication of the specific treatment applied. The researcher however, suggest that the reason for the poor attitude of students toward Mathematics might emanate from a number of factors which include teachers' disposition to students' aspiration and welfare. The result is in agreement with Good, Aronson, & Inzlicht (2007) who found in their studies that previous failures, discouragements from parents who did not perform well in Mathematics, negative attitudes of teachers, or comparison of low performing students with the higher performing students causes students to despair and give up studies in mathematical sciences. The authors thus concluded that mindsets have been discovered to impair or improve students' academic performance in Mathematics.

The study discovered that students in both experiential and action learning groups performed better than those in the control group in their performance scores in Mathematics. This implies that the use of experiential and action learning strategies constitutes effective strategies for enhancing students' achievement in Mathematics. The experimental groups jointly accounted for about 45% improvement in students' achievement in Mathematics. However, an inspection of the mean scores indicated that

students exposed to experiential learning reported slightly high level of academic performance. This is in line with Goldberg & Coufal (2009) who asserted that the experiential learning approach integrates academic content and peer partnership which is designed to increase students' understanding of the concepts and ideas in a particular subject. In addition, the result justifies the opinion of Afolabi (2012) who opined that action learning is an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task or create a product.

The study also confirmed that students in both experiential and action learning groups performed better than those in the control group in their attitudinal scores in Mathematics. This implies that the use of experiential and action learning strategies had the potency of enhancing students' attitude towards Mathematics. The experimental groups jointly accounted for about 53% improvement in students' attitude towards Mathematics. Although, students exposed to action learning had slightly highest adjusted mean scores on attitude towards Mathematics. The result conforms with the view of (Hassi & Larseen, 2009) who found that attitude of students toward the learning of Mathematics and about the nature of mathematical knowledge and skill on their own mathematical capability often determine their level of attendance and learning

Conclusion

Based on the findings of this study, it could be concluded that, the use of experiential

and action learning strategies enhanced better academic performance of secondary school students in Mathematics than the conventional method. Both experiential and action learning strategies are potent drive for positive attitude towards Mathematics. However, students exposed to experiential learning reported slightly high level of academic performance while those exposed to action learning had slightly highest adjusted mean scores on attitude towards Mathematics.

Recommendations

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

1. The potential of experiential and action learning strategies should be encouraged in Mathematics classroom to enhance better achievement of students in Mathematics.
2. Teachers should be encouraged to maximize the potential of experiential and action learning strategies in order to foster the interest of students in Mathematics career choice.
3. Mathematics teachers should be given adequate orientation through workshops and seminars to update their knowledge in the use of Experiential and Action Learning Strategies in Mathematics instruction.

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