THE EFFECTIVENESS OF ACTIVITY-BASED LEARNING ON STUDENTS' MATHEMATICS ACHIEVEMENT AT THE LOWER SECONDARY LEVEL

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Abstract

This study is undertaken to determine the effectiveness of activity-based learning on students' mathematics achievement at the lower secondary level. A quantitative research method was used to compare the students' mathematics achievement between the experimental and control groups. The design of the study was one of the true experimental designs, posttest only control group. The students from the experimental group were taught by using activity-based learning. The students from the control group were taught by using formal instruction. Two sample schools, BEHS (2) and BEHS (3) were selected by simple random sampling method. The findings of the study showed that students who were taught by using activity-based learning achieved significantly higher in the posttest than those who were not. The study proved the significant effect of activity-based learning.

Keywords: Effectiveness, Activity-Based Learning, Mathematics, Achievement, Mathematics Achievement

Introduction

Education plays a vital role in determining the quality of its human resources. The education sector provides a skilled workforce for people in the country. The advancement of a nation depends upon its quality of education. Education is the complete development of the individual of the child so that it can make an original contribution to human life according to the best of his capacity. It is the development of an individual according to his needs and demands of society, of which he is an integral part.

Mathematics is an essential subject. Therefore, to impart and transmit knowledge, it is necessary to understand what mathematics is and what its nature is. Mathematics can be defined in many different ways. It is an exact science that is related to measuring, calculating, discovering relationships, and dealing with the problems of space (Zubair, 2012).

Mathematics is a systematic, organized, and exact branch of science. It has its language and characteristics. It is called ritual and calculation as part of human life and knowledge. It is the science of logical reasoning and numerical problems. Therefore, the process of mathematics teaching and learning is an integral part of people's lives (Sidhu, 1995).

Purpose of the Study

The main purpose of this study is to examine the effectiveness of activity-based learning on students' mathematics achievement at the lower secondary level.

The specific objectives of this study are -

1. to investigate the mathematics achievement between the students who are taught with activity-based learning and those who are not.
2. to make suggestions and recommendations based on the result of the study about activity-based learning.

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Research Questions

The research questions of this study are as follows.

1. What are the differences in the overall posttest mathematics achievement between students who are taught by activity-based learning and those who are not?
2. What are the differences in mathematics achievement between students who are taught by activity-based learning and those who are not taught to answer knowledge level questions and application level questions?
3. How does mathematics achievement differ between students who are taught by activity-based learning and those who are not taught to answer comprehension level questions and analysis level questions?

Scope of the Study

The following points are the scope of the research study.

1. Participants in this research are Grade Seven Students from the selected schools: No (2) Basic Education High School and No (3) Basic Education High School in Pyinmana District, Nay pyi Taw Union Territory.

Definitions of Key Terms

The definitions of key terms are as follows.

Effectiveness

Effectiveness is the capability of producing an effect and is most frequently applied in connection with the degree to which something is capable of producing a specific, desired effect (Eslami, 2011).

Activity-Based Learning

Activity-based learning is a process whereby learners are actively engaged in the learning process, rather than "passively" absorbing lectures, it is based on the core premise that learning should be based on doing some hands-on experiments and activities. It involves reading, writing, discussion, practical activities, engagement in solving problems, analysis, synthesis, and evaluation (Festus, 2013).

Mathematics

Mathematics is a way to settle into the mind of children's habit of reasoning (Locke, 1975, as cited in Zubair, 2012).

Achievement

Achievement means an accomplishment or proficiency of performance in a given skill body or knowledge (Sasikala, 2012).

Mathematics Achievement

Mathematics Achievement is the competency shown by the student in the subject of mathematics its measure is the score on an achievement test in mathematics (Mangal, 2008).

Review of Related Literature

Theoretical Foundation of Activity-Based Learning

Learning theories attempt to explain how students think and what factors determine their behavior and learning. Learning theories are the basic raw materials, which are applied in the

teaching-learning process. So, it is important to understand the theoretical framework that active learning techniques are built upon.

In the constructivist theory, learning occurs when students become engaged in an activity that utilizes the content and skill they are learning. Any new information introduced during the activity that is consistent with current knowledge and understanding is either rejected as being wrong or is built into new knowledge. New knowledge is constructed when students combine new information with existing knowledge through the process of reflection (Adams & Burns, 1999).

Activity-based learning theory is a cognitive learning theory that is considered a "constructivist" learning theory. Students are active learners who should be given opportunities to "construct" their frames of thought. In learning activities, students are free to infer and discover their answers to important questions. Also, the student actively seeks new information and is actively engaged in the process in the way student gains, assimilates and utilizes knowledge.

Activity-Based Learning

Activity-based learning methods are based on the active engagement of learners in the learning process to acquire skills, knowledge, and attitudes. Activity-based learning practices aim to facilitate learning for the students. Activity-based learning can be a very efficient strategy to help students acquire a better grasp of the knowledge that is important to the class. Activity-based learning approach refers to the learning process where students mentally and physically explore the subject's content by forming identical situation of the work environment and handling the tools and materials that are similar to the world of work. This learning technique includes activities that enhance knowledge, skill, and attitude. Also, it will help to develop students' notions about the real world (Ravı & Xaviera, 2007).

Activity-based learning is also defined as any strategy ''that involves students in doing things and thinking about the things they are doing''. Active learning is defined as a method where the teacher is only a facilitator and the learner is at the center of the learning process by their high involvement in practical activities and discussion.

Different Types of Activity-Based Learning

Activity-based learning is achieved broadly in three ways, namely, exploration, experimentation, and expression. There's a wide range of activities that can be employed with activity-based learning (David Horsburgh, 1994, as cited in Festus, 2013).

Dramatization: An event, a story, or a novel is reconstructed into a dramatic presentation.

Quizzes: A competitive activity in which participants should give the answers to the questions in a prescribed period following some pre-determined rules.

Group discussions: Groups are formed and students discuss a given topic and reach a decision or arrive at some conclusions.

Role play: Students enact some situations or play the roles of characters

Educational games: Games are designed to help students learn a skill, enhance their understanding of concepts, and learns about certain subjects.

Brainstorming: Students produce a heap of ideas on a particular theme or a problem with no commenting on anyone's points of view.

Problem-solving: a process of finding the solution to the problem by using one or more concepts or principles or formulae or required information.

Debates: Discussion involving arguments between two groups in which one group argues to defend the controversial issue or theme and the other group puts up the arguments against the theme.

Fieldwork: Students experience real-life situations, collect relevant data, process and analyze the data, and arrive at conclusions.

Discovery learning: Students learn by exploring or discovering many aspects of the environment in their way.

Projects: Projects are aimed at achieving one or more definite goals of understanding. They involve investigating and finding solutions, planning, and carrying out to completion by students.

Concept mapping: It is a process of representation of the concepts or different things in a hierarchical fashion with the most inclusive, general concepts at the top and less general concepts at the bottom in a pictorial form.

Among the different types of activity-based learning, group discussion, brainstorming and problem-solving will be used**.**

Group Discussion

Group discussion may be defined as a form of a systematic and purposeful oral process characterized by the formal and structured exchange of views on a particular topic, issue, problem, or situation for developing information and understanding essential for decision-making or problem-solving (Hamann, Pollock & Wilson, 2012).

Steps in Using Discussion

To do this, several steps must be taken when conducting group discussions (Brewer, 1997).

Step 1. Introduction; The introduction should have four parts.

i. Instructional Objective.
ii. Purpose.
iii. Relationship and
iv. Advanced Organizer.

Step 2. Directing the Discussion and

Step 3. Summarizing the Discussion

Brainstorming

A structured approach to thinking helps a group of people utilize their collective brain power to generate new ideas (HarirForoush & Sadeghi, 2010, as cited in Rizi, Najafipour, Haghani & Dehghan, 2013).

Alrubai (2014) suggested that the brainstorming procedures for learning and teaching consist several of steps;

1. Dividing the class into the brainstorming groups,
2. Identifing the problem and time limit,
3. Generating of ideas,
4. Evaluating the ideas,

5. Selectiong of an idea, and
6. Implementating.

Problem-Solving Method

Problem-Solving is a set of events in which human being was rule to achieve some goals (Gagne, 1985, as cited in Zubair, 2012).

Problem-Solving is a planned attack upon a difficulty or perplexity for the purpose to find a satisfactory solution (Rick T M, 1985, as cited in Zubair, 2012).

Problem-Solving involves concept formation and discovery learning (Ausubel, 1918, as cited in Zubair, 2012).

Steps in Problem-Solving

The steps of problem-solving are given below.

1. Identifying and Defining the Problem
2. Analyzing the Problem
3. Formulating Tentative Hypothesis
4. Testing the Hypothesis and
5. Verification of the Result (Zubair, 2012).

Research Method

Research Design

In this study, one of the true experimental designs; posttest-only control group design was used.

Population and Sample Size

The required sample schools were selected by using a simple random sampling method. The sample schools were No (2) Basic Education High School (BEHS) and No (3) Basic Education High School BEHS. At No (2) Basic Education High School, only (29) students were selected by random sampling method from the population of (58) Grade Seven students in the academic year 2023-2024. In the same way, only (30) students were selected from the population of (60) Grade Seven students at BEHS, No (3), Pyinmana District.

Instruments

The instruments used for this study were a prerequisite test and a posttest. This test was constructed based on Grade Seven Mathematics Textbook Chapter (1) to (5) from Mathematics Textbook Volume (I) and Chapter (1) to (4) from Mathematics Textbook Volume (II). There were (25) multiple- choice items in the test and the total score of the test was 25 marks. The posttest was constructed to measure the mathematics achievement of the students. The posttest consisted of three sections. There were (10) multiple-choice items in section (A), three short questions in section (B) and two long questions in section (C). The allocated time for this test was 1:00 hour and the given marks are 50.

Learning Materials Used in the Study

Learning materials included lesson plans, Variety of teaching learning aids, and textbook and teacher’s guide.

Analysis of the Data

To determine if the groups were essentially the same before the treatment, the prerequisite test was used. Be able to determine if there was a significant difference between the experimental and control groups, the posttest scores of the two groups were compared using an independent samples *t* test. For the analysis of data obtained in the study, (Statistical Package for the Social Sciences) SPSS version 20 was used.

Procedure

In this study, a true experimental design will be used. Experimental group was provided treatment by using activity-based learning for two weeks. At the same time, the control group was provided treatment by using formal instruction to the same content for the same periods. The allocated time for this posttest is 1:00 hour and the given marks are 50 marks.

Research Findings

The main purpose of this study is to investigate the mathematics achievement between the students who are taught by activity-based learning and those who are taught by formal instruction. The findings of the study in each selected school are presented as follows.

Findings on Prerequisite Test

The prerequisite test was administered to both groups before the treatment was given. The data from the prerequisite test were carefully recorded and analyzed to compare the difference between the experimental groups and the control groups. The results of *t* test, the mean, standard deviations, and mean differences of both groups were presented as follows.

Table 1 ***Results of t values for Prerequisite Test Scores***

School	Group	*n*	*M*	*SD*	*MD*	*t*	*df*	Sig. (2-tailed)
BEHS (2)	Experimental	29	20.55	3.32	1.93	1.54	56	.12(ns)
	Control	29	18.62	5.87				
BEHS (3)	Experimental	30	19.27	6.18	1.14	0.68	58	.49(ns)
	Control	30	18.13	6.64				

Note. BEHS (2) = No (2) Basic Education High School, Pyinmana; BEHS (3) = No (3) Basic Education High School, Pyinmana.

ns = not statistically significant.

According to the *t* value for prerequisite test of BEHS (2) and BEHS (3) $t(56) = 1.54$, $p = .12$ (ns) and $t(58) = 0.68$, $p = .49$ (ns), it showed that there was no significant difference between the experimental groups and the control groups for the scores on the prerequisite test in each school.

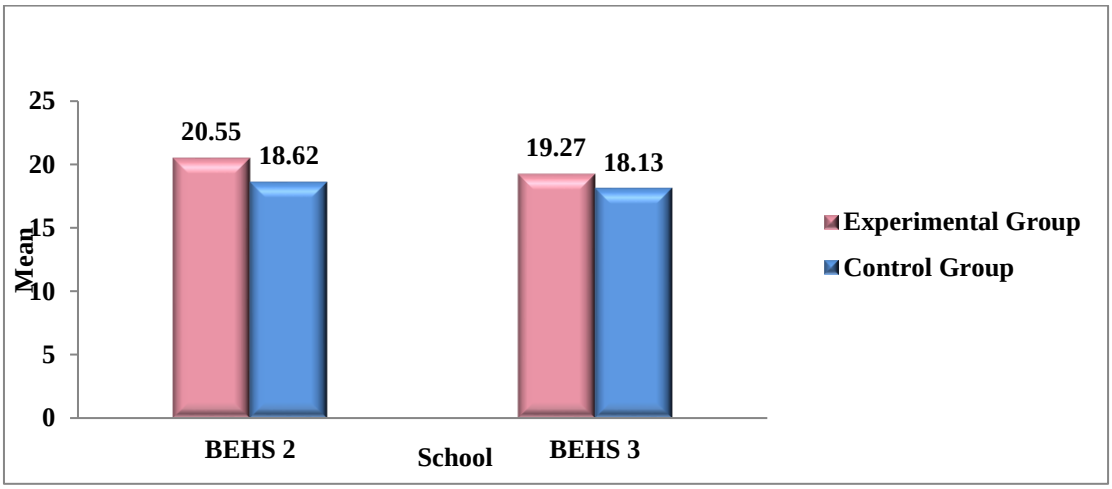

Figure 1 Comparison of prerequisite means for pretest.

As shown in Figure 1, the prior knowledge of the experimental groups and the control groups were equivalent.

Findings of Posttest on Mathematics Achievement

After administering the prerequisite test, the students from the experimental group were taught by using activity-based learning and the students from the control group were taught by using formal instruction. At the end of the treatment period, posttest was administered to measure the mathematics achievement of students. The posttest score data was recorded systematically. The results for posttest mathematics achievement are presented in Table 2.

Table 2 ***Results of t values for Overall Posttest Mathematics Achievement***

School	Group	*n*	*M*	*SD*	*MD*	*t*	*df*	Sig. (2-tailed)
BEHS (2)	Experimental	29	29.03	7.20	10.96	5.49	56	.000***
	Control	29	18.07	7.97				
BEHS (3)	Experimental	30	27.13	7.54	7.03	4.52	58	.000***
	Control	30	20.10	3.96				

Note. BEHS (2) = No (2) Basic Education High School, Pyinmana; BEHS (3) = No (3) Basic Education High School, Pyinmana.

*** $p < .001$.

Results showed that the mean of the experimental groups was significantly higher than that of the control groups in each selected school (see Table 2). According to the *t* values for overall posttest mathematics achievement of BEHS (2) and BEHS (3) $t\,(56) = 5.49$, $p < .001$ and $t\,(58) = 4.52$, $p < .001$, it showed that there was a significant difference between the experimental group and the control group for the scores on the mathematics achievement in each selected school. Comparison of overall means for posttest is described in Figure 2.

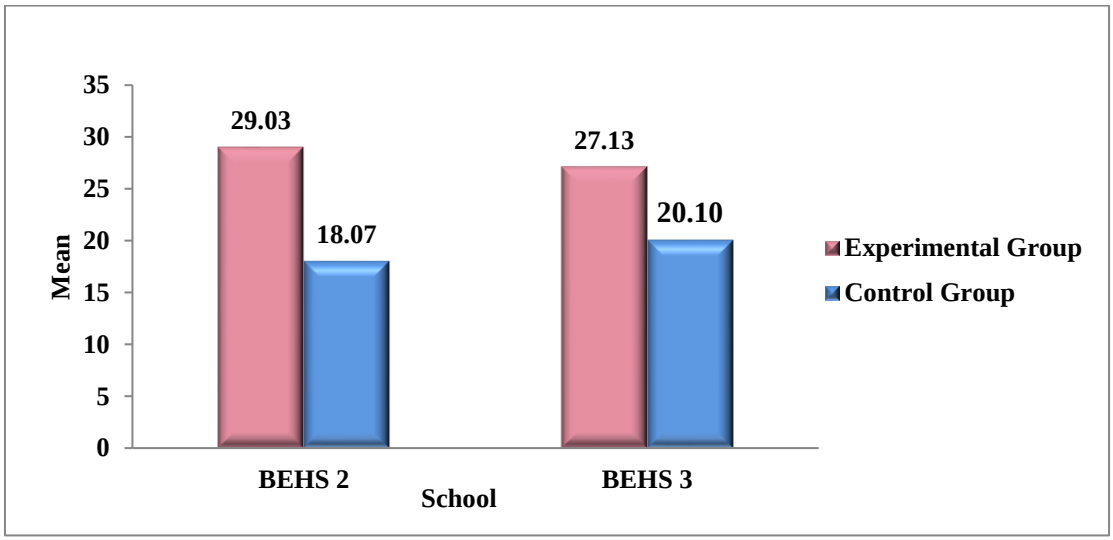

Figure 2 Comparison of overall means for posttest.

It can be interpreted that teaching by Activity-Based Learning, has significant effects on the mathematics achievement of the students. Therefore, teaching by ABL positively contributed to mathematics teaching at the lower secondary level to develop students' problem-solving skills, logical and critical thinking skills, creativity and reflection, self-directed learning, and higher-order thinking. Besides, the mathematics achievement for each cognitive level was analyzed. The questions were analyzed such as knowledge level questions, comprehension level questions, application level questions, and analysis level questions. To measure significant differences in mathematics achievement between the experimental group and the control group in performing knowledge level questions, an independent samples *t* test was used.

Discussion

No (2) BEHS and No (3) BEHS, the overall mathematics achievement of the experimental group was higher than that of the control group. It can be interpreted that teaching by ABL has significant effects on the mathematics achievement of the students. Thus, teaching by Activity-Based Learning positively contributed to mathematics teaching at the lower secondary level. This result was collaborated by Suydan, Marilyn, and Higgins (1997, as cited in Khan, et al., 2012), stated that ABL in teaching mathematics is more effective than formal instruction of teaching. According to the results, it is obvious that the use of ABL methods can improve students' engagement in teaching learning process, the recall and retention of knowledge, and critical thinking. The teacher has to closely relate the content of his subject to the basic needs and lives of his students. Therefore, mathematics teachers should use ABL in teaching mathematics to develop students' problem-solving skills, logical and critical thinking skills, students' creativity and reflection, advance self-directed learning, and higher-order thinking skills.

Suggestions

According to the results of the study, time was an issue. Activity-based learning took up more time than formal instruction. To get a wide range of mathematical concepts and processes, mathematics teachers should successfully implement activity-based learning in the classroom. The teacher should provide opportunities for their students to participate actively in teaching

teaching-learning process. The principals and administrators must support the mathematics teachers to implement activity-based learning in the classroom. Mathematics teachers should assess student understanding in more meaningful ways and try to increase and update activity-based learning. Students should be critical thinkers, presenters, accommodations, and active learners.

Conclusion

In Myanmar's formal school system, the teaching-learning process in the classroom should undergo a major reform. The teaching-learning conditions should be student-centered in the classroom. The teacher is not only a transmitter of knowledge but also an organizer of knowledge. The teacher should facilitate, guide, and provide for students to learn themselves. For this situation, activity-based learning is a suitable and effective approach. ABL encourages problem-solving skills, critical thinking skills, and creativity students' creativity and reflection, and advances self-directed learning, and higher-order thinking skills. Activity-Based Learning should be frequently used in the mathematics classroom to improve students' mathematics achievement. It can be concluded that ABL had positively contributed to the improvement of mathematics achievement at the lower secondary level.

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