Original Research Article

Investigating the Effectiveness of Peer Assisted Learning Strategy in Solving Mathematical Word Problems

Abstract

The purpose of this study was to examine the effectiveness of peer assisted learning strategy in solving mathematical word problems of grade seven in a general classroom. A pre-test and post-test quasi-experimental research design was employed involving 14 students in the control group and 16 students in the experimental group respectively. Subject achievement test was administered for both the groups to determine the differences in their learning achievements before the intervention. The instructional strategy used was Peer Assisted Learning strategy (PALS). Mathematical word problems solving was taught using PALS strategy in the treatment while the control was taught using a conventional method. A t-test for the pre-test revealed that there was no significant mean difference between the two groups, indicating a homogenous learning ability at the beginning (p=0.802). However, the post-test analysis revealed a statistical significant difference between the mean scores of experimental group (M=19.2) than the control group (M=10.9) at p=.00, indicating the improvement of students' mathematical word problem solving skills due to the treatment of PALS. Thus, it is commendable that PALS can be used to help develop academic and social skills.

Key Words: *Effectiveness, Word problems, Mathematics, Peer Assisted Learning Strategy*

1.0 INTRODUCTION

Mathematics holds a significant position in the contemporary world. It is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, and the social sciences. It is taught at all levels of education, to build students' mental capability, teach logical reasoning, critical thinking, analytical and problem solving skills. [1] lists the five basic building blocks of elementary mathematics as numbers, place value system, whole numbers, fractions and decimals and problem solving. [2] breaks math expertise into two components - math content and math maturity. Math content includes the arithmetic, algebraic and geometric procedures and how to use these procedures whereas math maturity includes understanding and solving problems that have not been encountered

before, mathematical logic and reasoning, precise mathematical communication, knowing how to learn math, problem posing, transfer of learning, and interest and intrinsic motivation in math. Word problem solving performance is strongly related to text comprehension and arithmetic skills and the word problem solving of difficult items required both text comprehension and arithmetic skills in good measure [3]. Mathematical word problems are a combination of numbers and words in which students apply Mathematics instruction in the context of a problem solving [4]. It is designed to help students apply mathematics concepts to real-life situations. Yet, mathematical word problems pose difficulties for many students because of the complexity of the solution process.

Although, Mathematics had always been highlighted as a main and mandatory subject in the schools of Bhutan. Yet, the learning achievement of Bhutanese learners in mathematics is still found low as compared to the rest of the subjects. Many learners had performed below expectations of their grade level on both basic and advanced academic skills, lacked basic communication and analytical skills. On average a learner required one additional year to achieve the same level of competency for that grade [5]. Bhutanese students who have had first-hand experience of learning mathematics in the Bhutanese classroom hold the scepticism that mathematics is either boring or challenging which has even resulted to parents' acceptance and toleration of low performance in mathematics [6]. The mathematics achievement of class VI students conducted by the National Education Assessment [7], for example, demonstrated students' performance to be "disappointingly low". The majority of the students struggle with the mathematics, in particular with 'word problems'. It was found in Bhutan PISA-D national report that students performed better in items requiring lower cognitive skills, however, there is a significant gap in performance in more demanding task [8]. The problem has become apparent particularly after having known the level of students' interest and word problems solving skills of students in the mathematics classroom. Discussion with critical friend and other colleagues also revealed that students lack mathematical word problems solving skills which hampers in achieving the learning outcomes in mathematics.

Thus, this action research was conducted with an aim to investigate the effectiveness of Peer Assisted Learning Strategy (PALS) in solving mathematical word problems.

2.0 Objectives:

1. To study the effectiveness of Peer Assisted Learning Strategy (PALS) in solving mathematical word problems of grade VII students.
2. To examine the differences in the mean achievement scores of grade VII students in mathematics after the interventions.

3.0Reconnaissance

In order to execute this action research, the researcher adopted the steps proposed by [9] which involved situational analysis, competence and literature review. These three components provide an overview of the realities of the situations, competences of the people involved, and link it with the review of literature.

3.1 Situational Analysis

Having serve as a Mathematics teachers for more than 21 years at various schools in Bhutan, the researcher has realized that many Bhutanese students perform relatively low in mathematics owning to the nature and difficulty of the subject. This problem has become more visible after teaching mathematics to grade eight students for two consecutive years. Having analyzed their unit test and term examination marks, the researcher found that most of the students have failed to solve mathematical word problems which in turn has impedes learning outcomes in mathematics. Further, the critical friend and other colleagues shared similar concerns, students lacking mathematical word problems solving skills in other grade as well. [10] states that many learners have difficulty solving word problems due to lack of comprehending word problems that come from the semantic structure of the problem and its language consistency with the required operations. [11] pointed out, word problems written in complex language is rated as mathematically more difficult to solve as the same problems written in simpler language. Children's achievement in mathematics is connected to long-term outcomes in both mathematics and literacy [12].

Therefore, the researcher decided to utilize peer assisted learning strategy as intervention to curb the current issue and to bring improvement in mathematics performance of grade eight students.

3.2 Competence

The researcher obtained Bachelor's Degree in Education from Paro college of Education, Royal University of Bhutan. He had been teaching mathematics for primary and lower secondary students for the last 21 years. Moreover, the researcher had also attended

Professional development programes on action research at Dzongkhag and school levels during the teaching journey.

3.3 Literature Review

3.3.1 Word Problem

Several definitions of mathematical word problem can be found in literature. Word problem is any Mathematics exercise where significant background information on the problem is presented as text rather than in mathematical notation [13].

[14] defined word problem as combination of numbers and words in which students apply Mathematics instruction in the context of problem solving. Conversely, [15] defined word problem as problem designed to help students apply Mathematics concepts to real-life situations. As word problems involve a narrative of some sort, they are occasionally also referred to as story problem and may vary in the amount of language used in the question.

[16] noted that one reason that students have difficulties in interpreting is because lack of spatial skills or mathematical imagination. Further, [17] reported that improvement in problem-solving abilities is dependent on mathematical knowledge as well as cognitive and metacognitive abilities. Mathematics instruction calls for methods that support students' acquisition and development of these processes. Writing has been acknowledged as one possible method to improve students' problem solving abilities.

[18] found out the ability to represent has a direct relation between efficient representation and efficient word problem solving ability. This ability has a factor on the students' ability to solve a problem. With this the teacher must give more emphasis on the student's ability to represent.

3.3.2 Peer Assisted Learning Strategy

Peer assisted learning is a collaborative approach, in which learners work in pairs or small groups to provide explicit teaching support. It is an organized learning experience in which the learners take on the responsibility for aspects of teaching and for evaluating the success of their peer(s). [19] defines Peer Assisted Learning (PALS) as the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions.

[20] asserts that PALS is method that can improve teaching and learning, provides a safe learning environment to promote learning and retention of knowledge. Students feel more comfortable asking questions to another student and in small or large group discussions, the students themselves have to hash out the different points that are brought to the table.

According to [19] claims that peer tutoring provides a platform for the students to use their knowledge in a meaningful, social experience. One student serves as the teacher or tutor, and one is the learner or tutee. Peer tutoring can be varied depending on who will be paired and what will be their roles. The peer could be same age, cross age and reciprocal tutoring. Such collaborative teaching practices help us refine one's ideas and better the solutions. It promotes teamwork relieving student isolation in a learning situation. Ultimately, it helps in achieving the learning objective. The diverse needs of students can be better met with peer-mediated instructions that involves students working together on structured tasks.

[21] states that peer assisted learning strategy (PALS) is a version of class wide peer tutoring, where students are paired as 'coaches' and 'players' with role reversal to work together on a particular topic. PALS, is a scientific-based peer-mediated instructional program. Clear instructional activities are planned in advance by the teacher and based on material that has been taught; Procedures and routines for working in pairs are taught by the teacher in advance of peer work; Members of pairs may differ in ability levels (reading, math, or English proficiency).

3.3.3 Overarching Research Question

How Can I Enhance Grade Seven Students' Mathematical word problem solving skills through the use of Peer Assisted Learning Strategy?

4.0 Methodology

The study employed quantitative research approach involving quasi-experimental design to investigate the effectiveness of peer assisted learning strategy in improving the mathematic achievement of grade eight students.

4.1 Sample

A convenience sampling method was adopted in this study. Such non-probability sampling procedure allows the researcher the freedom of choosing the informants based on the similarity of qualities [22]. A total of 30 (n=16 experimental, n=14 control group) seventh grade students studying in Khoma Lower Secondary School, Lhuentse, Bhutan were involved in the study.

4.2 Research Instrument

In this study, subject achievement tests(pre-test and post-test), and Peer assisted learning strategy as an instructional strategy were utilized. The subject achievement test (pre-test) was conducted before the treatment to establish the baseline knowledge of the students while the post-test was conducted to evaluate the effectiveness of peer assisted learning strategy. The test questions were submitted to the group of mathematics experts for the content validation.

The reliability of the instrument was established through a pilot test involving 20 participants who had already learnt the same test content in their previous grade. The test was found reliable after obtaining internal consistency Cronbach alpha 0.83 for the test items.

4.3 Data Collection Procedures

Approval from the Dzongkhag Education office and the consent from the participants was formally sought before the execution of this research. After the approvals, the study was arranged to take place after the school hours so as to avoid any hindrance to usual academic timings. The subject achievement test was conducted both for experimental and control group during the pre-test in order to draw the baseline knowledge of students. After the pre-test, peer assisted learning strategy was implemented to the experimental group for an hour. The control group was taught same content using a conventional lecture method for the same duration. Both the groups were then administered with the post-test that comprised of same content items with little modifications after the intervention period.

4.4 Data Analysis technique

The inferential and descriptive data analysis technique was used to present the research findings. The study findings are presented in the form of mean, standard deviation and the t-tests with short descriptions.

4.5 The Intervention: Scaffolding through application of Peer Assisted Learning Strategies (PALS)

A split list procedure was used to form a reciprocal pair for the experiment group (PALS) based on the assessment data (baseline data) and mathematics score of students in the previous unit. In this procedure, the entire class was ranked on ability and split in half. The student with the highest marks was paired with the student at the lower end of scale. The pairing was maintained effectively throughout the intervention period. In the pair, one student acted as a coach and the other as tutee and reversed their roles midway through the session. The investigator explained to the students how they would be solving the word problems in pairs. The students were briefed with a set of instructions that students need to follow while working in pair. They were provided a script to focus on during the interaction with each other. The investigator prepared this script and the script had questions and statements that would guide the player to carry on with the next steps and interactive hints and motivating

words for completing each step. The intervention was implemented for 3 months in which students and investigator met 3 times in a week.

5.0 Results

The pre-test and post-test were conducted to both the experimental and the control group with an aim to make a comparative analysis on the students' learning achievement in mathematics before and after the implementation of the Peer Assisted Learning Strategy. A statistical analysis of the mean score of pre-test and post-test for both experimental and control groups were compared using t-tests as presented below:

5.1 Pre-test Results

The t-test analysis for the mean scores of pre-tests for both experimental and control group was examined as shown in Table 1. There was no statistically significant difference in the mean scores of experimental group (M=9.25, SD=2.4) and control group (M=9.11, SD=2.3). The calculated p value 0.802 was found greater than the significant level .05 ($p>0.05$). Therefore, it was established that both the groups were homogeneous in solving mathematical word problems prior to the implementation of intervention.

Table 1 Comparison of pre-test mean scores of the control and experimental group

Groups	Number	Mean	SD	Sig 2-tailed
Control	14	9.11	2.3	
Experiment	16	9.25	2.4	0.802

Significant at the 0.05

5.2 Post-test Result

The post-test was administered to compare if the use of Peer Assisted Learning Strategy has impact on enhancing students' mathematical word problems skills. Using an alpha level of .05, the independent-samples t-test revealed a statistically significant difference as the obtained p value 0.00 was lesser than significant level 0.5($p< .05$) as shown in Table 2. The analysis of the group means for the post-test indicated that the experimental group (M=19.2, SD=3.8) performed significantly higher in the PALS than the control group (M=10.9, SD=2.5). This revealed that use of Peer Assisted Learning Strategy helped in enhancing students' mathematical word problem skills.

Table 2 Comparison of post-test mean scores of the control and experimental group

Groups	Number	Mean	SD	Sig 2-tailed
Control	14	10.9	2.5	0.00

Experiment	16	19.2	3.8	

Significant at the 0.05

6.0 Discussion

This study was executed with the aim to examine the effectiveness of the Peer Assisted Learning Strategy in solving mathematical word problems of grade seven students. The pre-test finding revealed that there was no statistically significant difference in the mean score of both experimental (M=9.25, SD=2.4) and control group (M=9.11, SD=2.3). This finding may be associated with the facts that traditional lecture-based teaching with books, chalk and board might have failed to offer interactive participation and not encouraged to develop critical thinking, problem solving skills as compared to cooperative and activity based learning strategies.

However, the findings of the study disclosed that the mean score of post-test for the experimental group (M=19.2, SD=3.8) in which students were taught using PALS was comparatively higher than the mean score of the control group (M=10.9, SD=2.5) that was taught using a conventional lecture method. The difference in the mean score reveals that the use of PALS had a significant influence on enhancing students' mathematical word problem solving skills. Thus, the statistical significant difference between the pre-test and post-test score was may be due to the effective intervention and not due to chance. The result of obtaining higher mean score for the experimental group as compared to the control group may be credited to the active roles and participation of the students as required at every stage of PALS. The findings align with [23] found out that students loved using PALS and found helpful in increasing mathematics skills. PALS also served as a tool to motivate students and inspired to work hard in math. Similar finding was claimed by [20] asserts that PALS helps in improving teaching and learning, provides a safe learning environment to promote learning and retention of knowledge. Students feel more comfortable asking questions to another student and in small.

7.0 Recommendation

In the light of the present research findings, following recommendations are proposed;

1. It is imperative for the teachers teaching mathematics to use PALS as an alternative strategy to teach mathematical word problems as it motivate and increase mathematical skills.

2. Peer Assisted Learning Strategy (PALS) may be used in teaching other subjects to observe if the technique bring similar outcomes.

8.0 Conclusion

The importance and effectiveness of PALS cannot be undermined due to its potential performance in enhancing students' learning outcomes as evidenced by the significant differences observed in in the mathematical performance of the students who received the PALS intervention in the study. The major finding of study established that there was statistical significant difference in post-test scores of both the experimental and the control group. When the teachers are confronted with many challenges such as larger class size and diverse learners, teachers need opt for stimulating teaching strategies like activity based learning, peer tutoring and cooperative learning strategies so as to keep the learners engaged, motivated and knowledgeable. The peer tutoring strategies such as PALS allow teachers to tackle the challenges in mathematics curriculum and support student diversity in classrooms.

CONSENT AND ETHICAL APPROVAL

The ethical issue has been taken into consideration by the researcher in this study. Written approval was availed from the concerned authority and consents were sought from the participants prior to the conduct of the research.

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