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# Effect of Problem Solving Approach on Achievement of Eighth Grade Students in Mathematics

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## Abstract

*This research paper was designed to study the effect of problem solving approach on eighth class students for learning mathematics. The study was experimental in nature. Quasi- experimental design (pre-test post-test control group design) was used in this study. The sample of the study was consisted of intact groups of students of eighth grade studying in a public girls' school of Lahore. These intact groups were randomly assigned to experimental and control group. Problem Solving Approach (PSA) for the treatment was developed by the researcher using George Polya's (1973) heuristics steps of the problem-solving approach, covering three units from the textbook of mathematics of eighth grade. Students of the experimental group were taught with PSA. The control group was taught with the traditional method. Result of the study revealed that students instructed through Problem solving teaching approach having higher scores than students taught through traditional method. It is recommended that teachers need to use problem solving approach for teaching eighth grade students to improve their achievement in mathematics.*

**Key Words**: Achievement, Eighth Grade Students, Mathematics, Teaching Method

## Introduction

Mathematics undertakes an essential job in the advancement of science and innovation. In our day by day life, the information of mathematics is significant. Mathematics is the establishment for science and innovation that no other region of science, innovation and business endeavor gets away from its application (Gusu, Mekonen, Tadesse & Reddy, 2015). Similarly, mathematics is the study of things that have an example of administrative, consistent request, discoveries and investigating the normality. Likewise, to comprehend the electronic world and to go with the recently creating data innovation, it is critical to have solid mathematical back ground(Okereke, 2006). Moreover, the current advancements in science have been as of late described with their mathematical plans. Mathematics is an indispensable piece of instruction and is a necessary subject in the educational plan across levels in the fundamental training level. In the basic level, mathematics requires something beyond playing out the four key activities of expansion, deduction, increase and division, or utilizing equation to discover a response to a given issue. One of the principle objectives is to make learner active problem solver (Torio, 2015).In addition, Mayanchi, Anya, and Kainuwa (2017) indicated that mathematics instructors recognize what to educate, when and how to educate. Henceforth, students should be provoked to concentrate successfully so as to make progress.

Jonassen (2011) stated that problem solving is a precise methodology that surveys learning abilities, grasping and forming, basic and imaginative reasoning In the line of previous study, Belecina and Ocampo (2018) indicted that problem solving portrays a circumstance wherein understudies are confronted with a valid and applicable undertaking on which they move in the direction of an answer or almost certain a final result**.** Furthermore, they also stated that in Problem solving method, role of the instructor is to depict for learners the terminal act which establishes the arrangement of the matter. In the view of Schoenfeld (2016) Polya's heuristic way to deal with taking care of mathematics questions is getting famous among math instructors. In addition, Problem solving approach was more operative than formal teaching techniques at improving mathematics accomplishment. In this way, they proposed that instructors ought to motivate and support learners to effectively pose problems, permitting learners to consider these problems. In addition, the most significant part of our new problem situated instructing technique is that learner can review problems and attempt to respond to these problems. The study may be helpful for mathematics teachers to improve students' achievement and beneficial for students to become problem solver in their learning (Hu, Xing & Tu, 2018). Hence, purpose of the study is to teach the students in what way they can adapt individually by utilizing Problem Solving Approach (PSA).

## Literature Review

Phuntsho and Dema (2019) revealed that significant purpose of instructing mathematics is to improve the capability to answer difficult problems that students faced in actual time. Mathematics, containing utilization of rational thinking, count of figures, investigation of effects altered principles, is frequently portrayed such as proper discipline that reviews ideas utilizing representative language. These days, mathematics is covering different sciences and applies in numerous jobs and self-controls. In this way, it is instructed as an obligatory necessary course in essential and auxiliary schools in numerous nations (Hu, Xing, & Tu, 2018). In line with result of previous study Yasin, Halim, and Ishar (2012) found that use of PSA in educating can improve the effects of learning, particularly in expanding information, getting, application, and furthermore accomplishment.

In the same way, a significant level of problem solving method is prerequisite to effectively answer problems. Similarly, Selcuk and Caliskan (2010) stated that Problem-solving approaches are meaningfully connected to the components engaged with problem-solving methods. So is an essential ability required by all students, and yet, can likewise be a complex mental effort. However, Diaz, Felmer, Randolph and Gonzalez (2017) indicated that to study mathematics, has important figure how to answer complications. Moreover, a calculated tricky can be characterized by utilizing meaning of tricky, as numerical issue is a difficult that involves calculated reasoning, test and a combination of recently logical numerical develops.

Schoenfeld (2014) stated that Problem-solving is an unpredictable procedure that includes different factors. The primary is the advancement of procedures and techniques uncommon to the showed topic, and another is the improvement of perspectives and common methodologies that can be utilized to build up a standard. Learners figure out how to make changed methodologies by functioning in difficult

circumstances. In addition, Malik, Shah, Iqbal, and Rauf (2010) described Problem solving method has two impressions; general problem solving recognized with broad areas and domain problem solving exceptional towards certain detailed range for example, arithmetic and art.However, Portoles and Sanjose (2008) concluded that problem solving process requires numerous abilities to be utilized together. The components of this procedure are; under-standing the problem, picking the fundamental data among the given decisions, changing over the acquired data into mathematical problems and arriving at the arrangement in the wake of playing out the important tasks(Saygili, 2017). In the PSA students' chance from inactive audience members of data recipients to energetic, allowed self-learner. Furthermore, it additionally moves the distinction of instructive projects from educating to learning. They likewise revealed that it empowers the learners immediate acquire other information in confronting the complications to stay unraveled as opposed to feeling weariness (Ali, Akhter & Khan, 2010).

Similarly, Patrick and McPhee (2014) reasoned that, Problem based learning influence emphatically certain different qualities, for example, critical thinking, data procurement, and data imparting to other people, bunch works, and correspondence. Correspondingly, issues understanding stands a conscious formerly genuine action, includes utilization of definite creative technique, advanced reasoning and orderly arranged strides aimed at obtaining expected objectives. Hence, essential point of this learning model is obtaining of such data which dependent on realities (Usman and Sule, 2017). Yu, Fan and Lin (2015) found that the instructors utilized this strategy such as instructive device to upgrade knowledge then down toward earth understanding, to have learners' problem solving abilities and to advance learners' self-directed learning skill.

Kotsopoulos and Lee (2012) indicated, problem-solving approach utilized in arithmetic course books depends on crafted by Polya. Polya's method contains four stages that have since an extensive time ago filled in as a guide for instructing critical thinking and researching critical thinking abilities. The premier theme of this learning model is securing of such data which dependent on realities (Ali, Akhter, and Khan, 2010). Hence, Polya (1973) recommended four stages in answering mathematics questions. These stages are understanding problem, devising a plan, carrying out the plan, and looking back (Polya, 1973). In first step, Polya trained instructors towards examine learners' studies, for example, Do you perceive all the words utilized in expressing the issue? What are you approached to discover or show? Is there enough data to assist you to discover an answer (Polya, 1945).In the second step students are persuaded to discover joins between information given and the obscure. This stage gives further understandings about the problems. Polya referenced that there are numerous practical methods to solve problems. In the third step learner's influence near the right arrangement both over instinctively, however each progression of arrangement might remain active for usage. Instructor needs to assume an organizer job whereas learners stay actualizing design. The last step is applying and considering the results, inquiring as to whether an alternate technique could be applied (Polya 1973). Singer and Voica (2013) found that problem-solving is central in arithmetic teaching as it exceeds mathematics. In addition, problem based method, know to handle problems, yet in addition how to sensibly function our way through problems we may confront.

**Teaching Method and Mathematics**

Mwelese and Wanjala (2014) revealed that arithmetic is a main coherent science whereupon different disciplines corresponding Chemistry, Physics and Biology focus. Furthermore, they found that it thought about a reason for public activity and the investigation of the whole universe. Similarly, Socas and Hernandez (2013) found that mathematical problems comprises the focus of arithmetic educational programs, as this is a significant part of instructive projects and creating people who are equipped for problem solving of mathematics teaching. Leong (2013) described that PS is regarded demonstration moving existing information to another circumstance. Students, while solving problems, join numerical ideas with mathematical operations and equations and apply them together. Similarly, Ozcan (2016) examined this methodology during the procedure is the most testing task for students. For instance, a student who knows the area computation equation of a parallelogram can solve a problem that is focused on directly calculated the region of a parallelogram. Although, when the student needs to compute the area of a parallelogram inside a novel type of question, she or he may neglect to move earlier information to the job that needs to be done and may not be able to tackle the problem.

In the line of previous study Torio (2015) identified that algebra as a subject is offered to first year optional school as central subject in mathematics. He also stated that this subject fills in as the fundamental foundation in dealing with problems in various mathematics subjects like Geometry and Trigonometry. In addition, this subject uses pictures, to address numbers or sums and express wide associations that hold for all individuals from a predefined set. Problem-solving approachperceives algebra primarily as a method for tackling solving problems that are defined in equations. The problem is the thing that estimation of the variable which assumes the role of an unknown; satisfy the necessary conditions (Socas & Hernandez, 2013).

**Teaching Method and Achievement**

Problem solving is a technique which covers a wide scope of mental capacities. Students ought to acknowledge what and why they are doing, and know the qualities of these techniques, so as to comprehend the methodologies totally and have the option to choose proper ones (Dunlosky, Rawson, Marsh, et al., 2013). Usman and Sule (2017) expressed that the introduction to problem solving approaches that learners get could assist them with improving their accomplishment, increment their enthusiasm for a subject, and change learner mentalities towards learning. In the line of previous study Ulva (2017), Problem-solving likewise includes a learner's readiness to acknowledge demands. Learners who can effectively solve a problem have great understanding aptitudes, can investigate different cases, can recognize significant parts of an issue, can gauge and make analogies and endeavor attempting different methods. Dunlosky, Rawson, Marsh (2013) study showed that most of learners are not capable enough in gaining information independently and in the utilization of this information to tackle regular day to day existence problems. In this way, problem solving teaching is reasonable way to deal with include students in higher order thinking operations like investigation, amalgamation and assessment.

Results of previous study Usman and Ikechukwu (2018) showed that students learn better by building answers for open-finished, complex, and problematic

undertakings with schoolmates, as opposed to listening passively to speeches. Furthermore, such exercises require significant investment yet can be amazingly compensating when learners accomplish their learning objectives. Capraro and Rupley (2012) considered the impact of reading and upgraded word problem solving. They likewise found that outcomes focused on that instructors need to contemplate learners inferring an answer and more as far as encouraging learner's utilization of the intellectual parts of examining and mathematics. In the previous study of Craig (2016) who examined order and examination of logical writing in mathematics. In addition, they found that the plan effectively watched positive changes over the trial time frame in student's degree of commitment with the mathematical material.

## Hypotheses

**Ho1**: There is no significant difference in the achievement mean scores of experimental group (before and after intervention)

**H02**: There is no significant difference in the posttest achievement mean scores of the experimental and control group.

## Material and Methods

In this study, researcher has used a quantitative research method that followed a quasi-experimental design (pretest - posttest control group design). Population of the study was VIII grade students in a government school of Lahore. The sample of this research consisted of intact groups of students of eighth grade who were studying in a voluntarily selected government school of Lahore. These intact groups were randomly assigned in two groups as an experimental group and control group (32 each intact classes).

## Instrumentation

The achievement test was assessed by utilizing objective and subjective type test. The test was developed, including units of mathematics textbook material of eighth grade with various cognitive levels, for example knowledge, comprehension and application. Subjective test was scored by using the rubrics adapted from Punjab Examination Commission (PEC). The achievement test involved 32 MCQs and 10 restricted response questions. Answer key was developed for checking objective items, representing 1.5 score for each right answer of MCQs. The content validity of the test was measured by four mathematics education experts for the accuracy of content and vocabulary. The achievement test was pilot tested on 20 students other than selected as sample.

## Procedure

Research was conducted for a period of sixteen weeks in the wake of receiving consent from school headmistress. Experimental group was instructed by Problem Solving Approach (PSA). Whereas the students of control group were taught same conventional method. Researcher collected data before the phase of intervention. Achievement Test from eighth grade mathematics textbook units ($6^{th}$, $7^{th}$, $9^{th}$ and $12^{th}$) of Factorization Simultaneous Equations, Fundamentals of Geometry,

Areas and Volumes and Information Handling were given to the students as a pre-test. Students study the mathematics as a compulsory subject in previous classes that was considered as the baseline. There are fourth steps of PSA which helped the students to become better problem solver. In this way, Polya's steps of heuristic method were considered for PSA of teaching mathematics. Teacher was guided learners to solve question by using PSA and arrive at result. Same academic achievement test was administered to both groups (post-test), one group after giving the treatment and to other group without giving any treatment. The experiment was conducted during the normal school periods in accordance with the school timetable. Instructor solved questions on white board with dynamic support of learner. Toward the finish of exercise, learners were given alike questions to do in the class. Both groups were used the same textbook, following the same curriculum content under the guidance of the researcher. The researcher herself was taught both groups.

**Results and Discussion**

Independent t-test was used to analyze the mean score of two groups (intervention and control). Moreover, Paired sample t-test was suitable to look at the mean scores of pre-test and post-test of interventional group.

Table 1
Comparison of experimental group's pre-test post- test achievement scores by Paired sample t-test

| **Groups** | ***N*** | ***M*** | ***SD*** | ***df*** | ***t*** | ***p*** |
|---|---|---|---|---|---|---|
| Pre-test | 32 | 24.81 | 4.572 | 31 | -62.958 | .000 |
| Post-test | 32 | 90.33 | 3.899 | | | |

*p<0.05

Above table 1 proved that at the *p* value (*p*=.000<0.05) noteworthy change was found between the mean scores experimental group's pre-test (M=24.81) and post-test (M=90.33). It showed that learnerstrained through Problem Solving Approach having higher scores than learners taught through conventional method.

Table 2
Comparison of experimental and control groups' post-test score of achievement by Independent sample t-test

| **Groups** | ***N*** | ***M*** | ***SD*** | ***df*** | ***t*** | ***p*** |
|---|---|---|---|---|---|---|
| Experimental | 32 | 90.33 | 3.899 | 62 | 52.22 | .000 |
| Control | 32 | 26.44 | 5.719 | | | |

*p<0.05

Above table 2 revealed that at the p value (p=.000<0.05), a noteworthy change between mean scores of control group (M=26.44) and experimental group (M=90.33) was found. It exhibited that achievement score of pupils of interventional group greater than pupils of control group who instructed with conventional method.

**Discussion**

The goal of education is to ready learners for solving problems challenged each day. Mathematics is a backbone of practically all the streams in scholarly areas. Mathematics is an educational plan content that has a capacity as an instrument of problem-solving to assist individuals solves problems in everyday life (Hadiyanti, 2018). The Calculated tricky can be characterized in utilizing meaning of tricky, as mathematical questions is a tricky that involves arithmetic logic, test desirable combination of previously learned arithmetical builds (Diaz, Felmer, Randolph, & Gonzalez, 2017).

PSA is an operative teaching technique to develop learners' achievement and increase their attention in a subject towards learning (Usman & Sule, 2017). This study found that significant difference in before and after intervention in experimental group regarding. The finding supported to the idea of Lestari (2019) who stated that mathematical thinking abilities whose learning with problem solving method is superior than the pupils who get knowledge in traditional way. However, the study found that after intervention students achievement scores higher than those who were studying formal method in post-test. These findings were in support of problem solving approach has a positive effect on the students of the experimental group (Khatimah & Sugiman, 2019). In addition, Ali (2010) found that significant difference in problem solving and conventional teaching method. Moreover, Parveen (2010) expressed in her study that students' achievement is better in problem solving teaching method than outdated method. Similarly, Hu, Xing, Tu (2018) further supported that problem solving was effective teaching method than traditional teaching methods.

**Conclusions and Recommendations**

It was determined that problem solving approach develops achievement of students. It was found the learners of treatment group have better scores after intervention than before receiving treatment. So, it proved that students of experimental group who trained through PSA having high marks than those students of interventional group's pre-test who taught through same traditional method. In addition, significant difference was found between post-test achievement mean score of experimental and control group. It was also proved that teaching-learning through PSA is more effectively than conventional method to develop achievement of learners in mathematics.

In the light of results and conclusions, Problem solving approach is operative teaching method than conventional technique. Recommendation for mathematics teachers who teach eighth grade students, they may be used PSA in their teaching to enhance learners' achievement towards mathematics. Recommendation for students who are learning mathematics in VIII classes, problem solving approach may be helpful to increase achievement scores towards mathematics for solving real life problems.

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