EFFECT OF PROBLEM SOLVING APPROACH ON STUDENTS’ MOTIVATION AND THEIR ACADEMIC ACHIEVEMENT IN MATHEMATICS AT ELEMENTARY LEVEL

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ABSTRACT

The purpose of this study was to investigate the effect of problem solving approach on students’ motivation and their academic achievement in mathematics at elementary level. The study was experimental in nature. Quasi-experimental design (pre-test post-test control group design) was used in this study. The population of this study was comprised of all elementary school students of eighth grade in Lahore. The sample of the study was consisted of the 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. Intact groups for pretest and posttest were utilized for data collection. Problem Solving Approach (PSA) for the experiment was developed by the researcher using George Polya’s heuristic steps of the problem-solving approach, covering four units from the textbook of mathematics of eighth grade. Students of the experimental group were instructed with PSA. The control group was taught with the formal traditional method. The experiment was conducted for a period of sixteen weeks. Two research instruments were used in this present experimental study. The questionnaire of MMS was adapted to measure students’ motivation towards mathematics at start (pre-test) and end of experiment (post-test).

Academic achievement test of mathematics was measured by using objective and subjective type test. Subjective test was scored by using the rubrics adapted from Punjab Examination Commission. Independent sample t-test and Paired sample t-test was applied to compare the mean scores of control group and experimental group. The study may be helpful for mathematics teachers to improve students’ academic achievement and beneficial for students to become problem solver in their learning. The result of the study indicated that students of experimental group who taught through problem solving approach were highly motivated towards mathematics as
compared to control group students who taught through same traditional method. The study revealed that students taught through Problem solving teaching method having higher scores than students taught through traditional method. Moreover, the results indicated that there was significant relationship between post-test of motivation and academic achievement of experimental group of learning mathematics after experiment.

**Keywords:** Problem solving approach; Motivation; Achievement; Mathematics;

*Eighth Grade Students*
DECLARATION BY SCHOLAR

It is certified that this PhD thesis titled “Effect of Problem Solving Approach on Students’ Motivation and Academic Achievement in Mathematics at Elementary Level” is an original research. Its content was not already submitted as a whole or in parts for the requirement of any other degree and is not currently being submitted for any other degree or qualification. To the best of my knowledge, the thesis does not contain any material published or written previously by another author, except where due references were made to the source in the text of the thesis.

It is further certified that help received in developing the thesis and all resources used for the purpose, have been duly acknowledged at the appropriate places.

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DECLARATION BY SUPERVISOR

It is to certify that the research work described in the PhD thesis is an original work of the author. It has been carried out under my direct supervision. I have personally gone through all its data, contents and results reported in the manuscript and certify its correctness and authenticity.

I further certify that the thesis has be compiled under my supervision and material included in the thesis has not been used partially or fully, in any manuscript already submitted or is in the process of submission in partial or complete fulfillment of the award of any other degree from any other institution. I, therefore, endorse its worth for the award of PhD degree in accordance with the prescribed procedure of university.

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Countless thanks to Almighty ALLAH, Creator of all of us; worthy of all praises who guides us in difficulties. All respects for His last Holy Prophet (Peace Be Upon Him) who enabled us to recognize our Creator.

“He, who does not thank to the people, is not thankful to ALLAH”

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CHAPTER I
INTRODUCTION

Mathematics assumes a crucial part in the advancement of science and innovation. In our everyday life, the information on mathematics is significant. Mathematics is the establishment for science and innovation that no other region of science, innovation and business venture gets away from its application (Gusu et al., 2015). Similarly, mathematics is the study of things that have an example of administrative, sensible request, discoveries and investigating the normality. Likewise, to comprehend the automated world and to go with the recently creating data innovation, it is critical to have solid numerical background (Siagan et al., 2019).

Moreover, the current advancements in mathematics have been as of late described with their mathematical procedures and modules. 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 elementary level, mathematics requires something other than playing out the four crucial activities of addition, subtraction, multiplication and division, or utilizing recipe to discover a response to a given problem. One of the principle objectives is to make learners active problem solver (Khatimah & Sugiman 2019).

In addition, Mayanchi et al. (2017) indicated that mathematics instructors recognize what to educate, when and how to educate. Not just have that, to comprehend why learners are experiencing issues in finishing mathematics assessment just as how to animate inspired by the subject. Subsequently, learners should be provoked to concentrate successfully so as to make progress. Dalida (2015) reported that there are numerous ways to deal with educating mathematics are known, such incorporate guided discovery, Problem solving, conversation, informative,
individualistic techniques. These strategies rely upon different types of teacher student engagements through certain techniques are more action situated than others. Singh et al. (2018) stated that Problem solving is a systematic approach that surveys learning capabilities, appreciating and forming, basic and innovative reasoning. Furthermore, he likewise depicted about these highlights are most significant components of reasoning and learning paying little regard to the affirmation of the significance of creating. Problem solving abilities moderately little exploration has been led on the topic in the field of instructional plan.

Problem solving includes various ways to deal with suit a given problem like theory and check, setting up condition, utilizing equations, drawing a graph, making a table or searching for a figure. It is therefore that educators should give more practice on the advancement of these aptitudes or capacities required for problem solving (Dalida, 2015). In addition, all things considered the problem solving is the manner by which to adapt autonomously. It is the most useful method to deal with accomplishes the goals of teaching learning process. The usage of problem solving method in rudimentary, subordinate and advanced directions has been extended (Seyhan, 2016). Similarly, each person resides in a dominant culture where communal, ministerial and creative circumstances are advancing continually.

Along these lines, teachers ought to break down and assess the current training patterns so as to choose suitable educational plans and techniques for guidance which will prepare students for genuine circumstances (Ali et al., 2010). Radmehr and Drake (2018) indicated that the methods towards mathematics change with presentation to mathematics, however the degree of changes might be identified with the nature of make decisions about the problems of human living. Consequently, figuring out how to plan a problem based educational program is significant for
teachers today. In the line of previous studies, Belecina and Ocampo (2018) stated that problem solving portrays a circumstance wherein students are confronted with a credible and important undertaking on which they move in the direction of an answer or more probable a final result. They additionally expressed that in Problem solving teaching approach, the function of the educator is to depict for the learners the terminal exhibition which establishes the answer of the problem.

In addition, Aken and Berends (2018) consider the students entering conduct for the idea and standards; they should take care of the problem. In this way, teacher ought to confirm the learners' learning by expecting them to give a full example of the problem solution. Akinwumi and Falemu (2017) defined Problem-solving is the method of exploration where the result is not evident to the agent at the preliminary stage. The related ideas in the intellectual structure of the learners must be satisfactory before the learners will be capable to resolve a given assignment or problem successfully.

Alvi and Nausheen (2019) identified as a teaching technique, problem-solving involves preparing the students on the best way to tackle problems by continuing in a logical step by step way from a problem state to its answer. It is on this reason scholars in problem solving have distinguished fundamental phases associated with the method. In addition, problem solving is an essential part of all arithmetic learning, and thus it has importance in math program (Ersoy, 2016).

Mataka et al. (2014) demonstrated that students using problem-solving heuristic were more assured at had a higher capability to solve tricky mathematics problems. Similarly, Eshetu and Assefa (2018) found that problem-solving approaches are essentially connected to the components associated with problem solving methods. Along these lines, it is a fundamental ability required by all students,
and yet, can likewise be a complex mental action. Ozsoy and Ataman (2017) described that problem solving is a logical technique, it includes the usage of essential, innovative and insightful thinking, explanatory and synthetically capacities, and left its blemish on the recent period has tenure among the targets everything being equal. In the same way, problem solving approach supports the instructor to create eagerness towards mathematics among the learners.

In the view of Schoenfeld (2016) Poly'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 (Hu et al., 2018).

Mathematics as a core subject in all elementary schools learners appear to have stayed extremely poor. In Pakistan, instructors working in public institutes keep on utilizing traditional methods of teaching in instructing of mathematics at elementary level (Behlol et al; 2018). In addition, it is noticed that mathematics is one of the highest poorly taught and dreadfully understood subjects in elementary schools of Pakistan (Ali et al., 2010). However, this study was conducted on eighth grade compulsory subject mathematics.

Thus, rationale of present study analyze the impact of problem approach on learners' motivation and academic achievement for learning mathematics in elementary schools of Lahore. As accomplishment of fifth and eighth grade students is assessed toward the year’s end concluded the Punjab Examination Commission
(PEC) assessment in this way, there is have to make the pupils' learning according to the objectives of students learning outcomes (SLOs) that are known in curriculum 2006. One of the objectives of curriculum, 2006 may to build learners inventive and problem solver learners rather than rote learner. PEC assessments depend on innovative thought instead of just relying upon learned information. In the result, pupils face in endeavoring undertaking the examination. As such, the explanation in neglecting to endeavor assessment is, instructors are showing learners by utilizing the conventional techniques and relies just upon learned information in our Pakistani public institutes. Concisely, it makes an extensive space among learner knowledge and expected pupils considerate results which are assumed in National Curriculum 2006 in math content. Hence, it is important to cover this space so as to accomplish the objective and learners' learning results.

**Statement of the Problem**

The aim of this study is to prepare students with problem solving approach because culture of Pakistani schools is instructor focused and educator ruled where pupils are inactive. In Pakistani Public schools, pupils learn methodically remembrance thus, it is important to instruct pupils to learn by understanding which is deep rooted learning (Ali et al., 2010). Furthermore, it is necessary to impart learners by those approaches which will be made them dynamic students side by side empower them to become problem solver in the direction of their learning.

Problem solving approach as an instructional teaching method support learners with utilizing open inquest approach in figuring out how to apply logical information, in actuality, circumstances. On the contrary, conventional strategy where learner becomes inactive in the instructing interaction that does not develop problem solving abilities (Aidoo et al., 2016). In addition, problem solving approach needs learner
focused learning climate in which a pupil is the focal figure of the learning cycle. The individualized, self-guided learning gives autonomy to the student to choose about learning themselves under the direction of instructor (Behlol et al., 2018).

Motivation is a fundamental factor in learning. Motivation to learn is a drive from inside an individual to make changes that are set apart by the rise of sentiments and responses to accomplish objectives. Similarly, motivation to learn is additionally a need to create self-capacities ideally so they can improve, dominate, and be innovative. Furthermore, learning motivation inspires learners to learn cheerfully and truly, which shapes a method of instructing understudies that are orderly, loaded with fixation, and ready to choose their exercises (Rahmawati et al., 2020).

Mathematics has been viewed as a fundamental section of learning in teaching whose implication is required in regular day to day existence. Problem solving method for the students to find their numerical abilities and assists them answer their questions with motivating inquiries, the educating may improve their reasoning capacity (Osuafor & Joseph, 2017). According to National curriculum of Pakistan for grade I-VIII, Mathematics is considered as compulsory subjects (Government of Pakistan, 2006). Therefore, the objective of this study is to examine problem solving approach effect on learners’ motivation and achievement on grade VIII compulsory subject mathematics.

**Objectives of the Study**

The following were the objectives of the study:

1. Find out the effect of Problem Solving Approach (PSA) on students’ motivation in mathematics at elementary level.
2. Examine the effect of Problem Solving Approach (PSA) on students’ academic achievement for learning mathematics at elementary level.
3. Identify the relationship between student’s motivation and academic achievement in mathematics at elementary level.

**Null Hypotheses**

The following were the null hypotheses of the study:

**Ho1.1** There is no significant effect of Problem Solving Approach on students’ motivation in mathematics at elementary level.

**Ho1.2** There is no significant difference in pre-test post-test motivation means score of experimental group.

**Ho1.3** There is no significant difference in the pre-test post-test motivation means score of control group.

**Ho1.4** There is no significant difference in the pre-test motivation mean score of the experimental and control group.

**Ho1.5** There is no significant difference in the post-test motivation means score of the experimental and control group.

**Ho2.1** There is no significant effect of problem solving approach on students’ academic achievement in mathematics at elementary level.

**Ho2.2** There is no significant difference in the pre-test post-test academic achievement means score of experimental group.

**Ho2.3** There is no significant difference in the pre-test post-test academic achievement means score of control group.

**Ho2.4** There is no significant difference in the pre-test academic achievement mean score of the experimental and control group.

**Ho2.5** There is no significant difference in the post-test academic achievement mean score of the experimental and control group.

**Ho3.1** There is no noteworthy relationship between students ‘motivation and
academic achievement in mathematics at elementary level.

Ho3.2 There is no noteworthy relationship in pre-test of motivation and academic achievement of experimental group in mathematics.

Ho3.3 There is no noteworthy relationship in post-test of motivation and academic achievement of experimental group in mathematics.

Ho3.4 There is no noteworthy relationship in pre-test of motivation and academic achievement of control group for learning mathematics.

Ho3.5 There is no noteworthy relationship in post-test of motivation and academic achievement of control group in mathematics.

**Significance of the Study**

This study may be beneficial for students to become more problem solver with their learning, and then there are possibilities to affect their achievement. This study may also be useful for those students who are used to learn lesson by rote learning because it may enable them to learn through understanding. They may be aware about their weak and strong aspects of learning through monitoring. In this way, problem solving approach may affect the motivation level and academic achievement of the students. Problem solving approach may develop students’ basic reasoning; increase their critical thinking aptitudes, increment their inspiration and may likewise assist learners with figuring out how to move information to new circumstances. This study may be helpful for mathematics teachers to improve students’ academic achievement in Pakistani institutes where customary culture of instructing is winning.

Teachers may able to provide opportunities to learners for practicing the Problem solving approach (PSA) for improving their academic achievement. This study may help institute mathematics educators how to assist learners with making them mindful about problem solving methods by containing the exercises into their
instructing cycle. The National Curriculum (2006) focuses the improvement of problem solving based learning and advancement of affirmative perspectives towards learning of mathematics (Government of Pakistan, 2006). Along these lines, the study may acquaint problem solving approach with the educators to be utilized as a viable learning procedure for advancing of important learning. The study may likewise assist reading material authors with joining problem solving approach alongside customary substance to introduce coherent ideas in more important manner to satisfy the requirements of the National Curriculum.

**Operational Definitions**

**Problem Solving Approach**

A Problem solving approach is a student focused instruction approach that connects with students energetically in the learning procedure and urges them to get ideas and create practical abilities genuinely. Moreover, fourth steps of Polya heuristics Problem Solving Approach (PSA) was helped the learners to turn out to be better problem solver.

**Traditional Method**

A teacher centered teaching method where the student is an inactive recipient of information and instructor an energetic transmitter of knowledge.

**Motivation**

Motivation is person's inward status toward something. It has capacity to upgrade the quality of the connection between the information and the yield of human conduct. Motivation states to the purposes behind coordinating conduct towards a specific objective, taking part in a specific action, or rising strength and determination to accomplish the objective. Intrinsic motivation of learners is related with those exercises which are identified with their own prize. While, extrinsic motivation
identified with outside components, for example, motivating force, prize and discipline.

**Academic Achievement**

Academic achievement is the results of the pupils on Achievement Test. It is assessable by scores.
CHAPTER II

REVIEW OF LITERATURE

Usman and Ikechukwu (2018) study revealed that Problem-solving approach (PSA) is a strategy that can possibly generate operative and remarkable teaching and learning as it is a method that is applied experientially and is student centered. So as to the execution of problem solving in the instructing and learning environment could improve learning. In the same way, through this method, students need to discover data and solve problems through their own struggles; this process makes them to be self-directed and to think critically and inventively.

In the same way, Simamora et al. (2017) found that the usage of problem solving strategies in instructing and learning can develop the outcomes of learning, particularly in expanding information, getting, application, and furthermore accomplishment. Correspondingly, an elevated level of critical thinking abilities is needed to effectively tackle problems and so as to ace these aptitudes; learners must utilize the methods regularly.

Hu et al. (2018) concluded that mathematics is not just the mother of entirely discipline yet in addition foundation of entirely logical exploration. In other words, arithmetic involving the utilization of construct and rational thinking, the figuring of quantities, and the investigation of things enriched standards, is frequently portrayed such as a proper discipline that reviews ideas utilizing representative language. These days, mathematics is covering different sciences and applies in numerous callings and orders. Thus, it is educated as a required obligatory course in essential and auxiliary schools in numerous nations. However, Diaz et al. (2017) indicated that to learn mathematics, it is as yet important to figure out how to solve problems. Moreover, a numerical subject can be described by using the importance of an issue, as numerical
tricky is a problematic which requires mathematical thinking, challenge and a mix of
as of late learned mathematical creates.

**Problem Solving Process**

Schoenfeld (2014) stated that Problem-solving is an unpredictable process that includes different factors. The first is the perfection of procedures and rules remarkable to the demonstrated subject, and another is the progression of viewpoints and general strategies that can be used to develop a norm. Learners figure out how to make new procedures by functioning in problem circumstances, and solving new sorts of problems by controlling these techniques. In addition, Malik et al. (2010) defined problem solving method with binary contentions; general problem solving associated with general ranges and area specific problem solving remarkable to some particular extents, for example, mathematics or science.

Similarly, Roesch et al. (2015) expressed that individuals as for the circumstance and level of their dominance, interchange among general and explicit space techniques. On getting more space data, the general systems are used less and critical thinking ends up being more area explicit. However, Portoles and Sanjose (2008) inferred that problem solving is a situational process that depends upon the significant configurations of information. Problem solving process requires numerous aptitudes to be utilized together. The components of this process are; understanding the issue, picking the fundamental data among the given decisions, changing over the acquired data into numerical images and arriving at the arrangement subsequent to playing out the essential task (Saygili, 2017).

**Problem Solving Approach**

Ali et al. (2010) focused that, in the problem solving approach the learners’ chance from inactive audiences’ members of data beneficiaries to dynamic and
critical thinkers. Furthermore, PSA exchanges the importance of instructive projects as a educating to knowledge. They likewise portrayed that it empowers the learners to learn original information by confronting the difficulties to be explained as opposed to little exhaustion.

In the same way, Patrick and McPhee (2014) determined that, Problem solving influence decidedly certain different credits, for example, critical thinking, data securing, and data offering to other people, bunch works, and correspondence. Likewise, Usman and Sule (2017) revealed that problem solving is an intentional and genuine act, includes the utilization of some novel technique, higher reasoning and orderly arranged strides for the obtaining set objectives. The fundamental point of this learning model is procurement of such data which dependent on realities.

Yu et al. (2015) found that the educators utilized problem solving strategy subsequently an instructive device to upgrade information consequently an applicable including useful valuable knowledge, to have learners' critical thinking aptitudes and to advance learners' free learning expertise. Correspondingly, Wilder (2015) showed Problem based learning condition, in which learners go about as experts and are challenged with issues that entail plainly characterizing and efficient issues, creating theory, evaluating, examining, using information from various sources, studying preliminary postulate as the information gathered creating and supporting arrangements dependent on proof and thinking. Furthermore, Birgili (2015) expressed that Problem based learning as a way of thinking intends to plan and convey an all-out learning condition that is comprehensive to learner focused.

**Theoretical Framework of Problem Solving Approach**

Widyatiningtyas et al. (2015) described that Problem solving has recently expanded consideration of the mathematics instruction network, however problem
solving was constantly seen as a component of mathematics. From that point forward, various analysts and associations archived proceeded with enthusiasm for problem solving by highlighting its different perspectives in arithmetic instructing. On the other side, Polat and Kesan (2013) revealed that Problem solving can be a couple used to notify our learners with the excellence that is absolute in arithmetic yet it very well may be additionally be the bringing together string that ties their mathematics encounters to assemble into a significant entirety. Hu et al. (2018) recorded that primary depiction of problem solving was sketched by George Polya (1945) in his volume *How to solve it*. Similarly, Polya (1957) proposed that problem solving could be presented as a functional workmanship, such as playing piano, as a demonstration of request and disclosure to build up learners’ capacities to become practicable problem solvers and independent masterminds. Likewise, the significant subject of doing sums was problem solving and it was imperative to instruct learners to ponder (Polya, 1973).

In addition, Polya’s stages are notable and are additionally considered and built a theoretical storm cellar for the current examination. Similarly, Polya (1981) characterized mathematical problem solving as a process that includes a few exercises and the utilization of heuristics as an arrangement for tackling problems. Besides, Polya heuristics is the procedure by which a problem solver endeavors different ways to deal with discover answer for a question (Lee, 2017).

**Problem Solving Approach through Constructivist Framework**

Problem solving approach as an instructional technique dependent on constructivism is the possibility that students make their individual perception by concerning strong understanding to prevailing data where process of cooperative and thinking are incorporated (Ajai et al., 2013). Constructivism theory accepts that
learner's information was developed by effectively thinking about their encounters however not latently getting from the others. In educating of mathematics, one of the signs of constructivist is problem solving and they underscored it as an explanation of learning mathematics. Rational mathematically goes about as a method for the universe of problem solving (Schoenfeld, 2013).

Constructivist learning is established on learner's active contribution in problem solving and critical thinking with respect to a learning movement. Learners build up their own understanding by thought-provoking considerations and methods reliant on their prior data and knowledge, relating them to new condition and planning data got with past academic forms (Albay, 2019). The instructor is a facilitator or a mentor who controls the learner's basic reasoning, examination and union capacities all through the learning process. The instructor is likewise a co-student in the progression (Bay et al., 2012).

The basic foundations of problem solving method are originated in Dewy's perspectives that knowledge gained through performing. Furthermore, Dewey (1938) discovered that schools should instruct learners to be problem solvers by helping them figure out how to think, instead of basically having them learn a lot of data through memorization (Osterman & Brating, 2019). Similarly, Dewey's view is that schools should concentration on creating judgment instead of information, so younger students would form into grown-ups who can make decisions about the problems of human living. Thus, learning how to plan a problem based curriculum is significant for instructors today (Boud, 2012).

Moreover, social constructivist approach is noteworthy for students have high level information and abilities, for example, critical thinking, investigation, union, basic reasoning and profound comprehension. Hence, in a social constructivist
learning condition, educators take on jobs helping students to get and improve high level abilities like examination, problem solving (Amineh & Asl, 2015). In social constructivist theory, study hall is a scholarly society and learning happens by methods for peer collaboration, learner responsibility for educational program and instructive encounters that are true to the learners (O’Shea & Leavy, 2013).

In problem solving circumstance, Vygotsky considers instructors to be peers as living agents of the way of life with whom the students associate. Educators are considered as methods for progress of the information on a specific culture. Consequently, for Vygotsky, problem solving is an agreeable movement (Ranjan & Padmanabhan, 2018). Furthermore, Vygotsky accepted that learning happens when learners work or figure out how to deal with complex undertakings or problems that are as yet inside the psychological reach of learners or those responsibilities are in the Zone of Proximal Development (ZPD) (Taylor, 1993). So also, Vygotsky expressed that ZPD is between the real degree of advancement as decided through free critical thinking and the degree of expected improvement by way of chosen problem solving in the direction of grown-ups or working with more able supporters (Simamora & Saragih, 2019).

**Problem Solving Approach through Cognitivist Framework**

Bahar and Maker (2015) expressed that the idea of problem solving is mentioned by instructors as a significant level mental process comprising of scholarly capacity and major intellectual processes. Jean Piaget’s work was the premise of psychological constructivism, which examines the system of accommodating cognitive structures as a separately built method. Instructors should encourage intellectual change by introducing troubles through explicit assignments that present dilemmas to learners. The advanced level of knowledge including move and use of
the information and comprehension to new circumstance can be accomplished through problem solving (Padmanabhan & Rao, 2011).

Piaget recommended that so as to recognize how youngsters deliberate we should take a glance at their capacity to solve out the problems. As, thinking is a fundamental ability required in problem solving by which learners produce reasoning out of practices (Ghazi & Ullah, 2015). Problem solving requires the capacity to recognize and interpret the problem, propose requires the ability to identify and describe the problem, suggest and design the prospective responses, test probationary answers, assess the result and reexamine these means when fundamental. Moreover, thinking abilities and steps in problem solving can be educated by furnishing with problem circumstance and chances to unravel these circumstances (Bornert & Wilbert, 2015).

 Though, in constructivist approach, youngster builds his own thoughts. Human cerebrum assumes a significant part to assist students with building a complicated, incredible and unique mental structure. The significance lies in the way that simple perusing and repetition remembrance do not prompt important learning. The possibility that we develop in our understanding and its application is the genuine learning. In this manner constructivist approach is said to improve the learners’ problem solving capacity (Bay et al., 2012).

**Problem Solving Approach Model**

Kotsopoulos and Lee (2012) stated problem solving approach utilized in mathematics reading material depends on crafted by Polya. Moreover, Polya's heuristic model contains four stages which have since quite a while ago filled in as a lead for encouraging problem solving abilities. The essential point of this learning model is securing of such data which dependent on realities (Phuntsho & Dema, 2019).
Thus, it is four stages technique Polya's (2004) stages of PSA which works deliberately to arrive at the answer of a mathematical problem that is, we should initially understand the problem; we should see obviously what is mentioned. Second, we should perceive how things are associated, how the obscure is associated with information, to get thoughts regarding solutions, to formulate a plan. Third, we carry out the plan. Fourth, we looking back to the solutions that have been gotten, we check them again and examine them.

**Step1: Understanding the problem (Description)**

The primary step of the problem solving measure understanding the problem. The learner must perceive clearly what is required. Questions that the pupil must test are: what is the obscure? and what is the data? Furthermore, the pupil ought to likewise think about drawing a figure and presenting a reasonable documentation. The pupil may need to isolate the different pieces of the condition and record them. Polya trained educators to ask pupils questions; for example, Do you see all the words utilized in expressing the problem? What are you approached to discover? Would you be able to rehash the problem in your own words? Would you be able to think about an image or chart that may assist you with understanding the problem? Is there enough data to empower you to discover an answer (Polya, 1945; Polya, 2004).

For the framework of stage 1 as for the understanding of the problem, finds the aslant of a quadrilateral parallelepiped of which the distance, the breadth, and the altitude are vague. In the past starting the underlying stage it is vital that pupils may have certain prior data about Pythagoras equation and its practices in plot Geometry. Consequently it is the focus for the instructors who need to utilize this procedure before handling a problem; pupil must have particular earlier information about the quantities in the subject. In place of giving perfect idea with respect to the
troublesome instructor may utilize solid outline so pupil may consider that what is the authentic problem (Polya, 1957).

**Step 2: Devise a plan for solving the problem (Planning)**

On this period pupils are persuaded to find links among data listed and the unidentified. This phase gives further knowledge related to question. Polya referenced that there are numerous sensible approaches to tackle problems. This step analyzed the various components of a problem from a multiplicity of approaches to recognize an answer strategy that will work. In like manner, the ability at picking a fitting approach is best learned by solving numerous problems. At that point, you will discover selecting a technique progressively simple. Henceforth, a partial list of approach is incorporated:

- Plan a design.
- Decide whether a similar approach can be useful.
- Analysis a less complex or extraordinary instance of question to pick up knowledge into the answer of the question.
- Draw a table and graph.
- Generate a mathematical statement or question.
- Use supposition and review.
- Work in reverse.
- Discover the major objective. (Polya, 1981).

**Step 3: Carry out your plan (Implementation)**

After an attentive arranging at the stage 2, what has been chosen is currently executed to reach at an answer. This step is normally simpler than devising the plan and completes the selected procedure and assesses the precision through thinking. Learners give to the correct arrangement each by instinctively or officially, however
every step of the plan might be clear for execution. For instance;

\[ K^4 - 8K^2 + 15 = 0 \]

It was considered that the arrangement pattern can be such as:

\[ K^4 = (K^2)^2 \quad \text{and} \quad Z = K^2 \]

Now, new equation would be \( Z^2 - 8Z + 15 = 0 \)

By factorizing \( Z^2 - 5Z - 3Z + 15 = 0 \)

\[ Z (Z - 5) - 3(Z - 5) = 0 \]

\[ (Z - 3)(Z - 5) = 0 \]

Then \( (Z - 3) = 0 \) and \( (Z - 5) = 0 \)

\[ Z = 3 \quad \text{and} \quad Z = 5 \]

It may be perceived that the arrangement is functioning and issue can be settled by this arrangement. Instructor needs to assume a helper character whereas learners are actualizing the blueprint (Polya, 1973; Simamora & Saragih, 2019).

**Step 4: Look back (Checking)**

During fourth step, Polya stated that a lot to can be gotten by putting aside the push to convey and check at how pupil have completed. This performance will engage the pupil to anticipate what technique to practice to tackle upcoming questions. This step is applying and pondering the outcomes and results, inquiring as to whether an alternate technique could be applied (Polya, 1981). In the same way, the learners ought to look at the result achieved. Possible questions are the following: Can I check the result, or argument? Can I originate the product in a different way? Can I utilize the outcome or approach for another problem? Can she comprehend the approaches of others to tackling problems and distinguish correspondences between various approaches (Polya, 2004).
Singer and Voica (2013) found that in this teaching approach, students are relied upon to figure out how to apply and adjust a change of proper approaches to tackle problems. Furthermore, these approaches incorporate utilizing charts, searching for designs, posting all prospects, attempting extraordinary qualities or cases, working in reverse, speculating and checking, making an identical problem, and making a less complex problem. Similarly, problem solving is pivotal in mathematics instruction since it rises above mathematics. Likewise, Manapure (2011) referenced that by creating problem solving abilities, we learn how to handle mathematics problems, yet additionally how to perceptively deal with problems we may confront.

Codina et al. (2015) explored the Schoenfeld (2013) arranged model for investigating numerical problem solving that got from Polya' work. In addition, they built up a model in five scenes: perusing, examination, investigation, execution and check. In this model, procedures are called scenes. As, every scene speaks to a timeframe through which single or gathering of issue solvers are occupied with an undertaking and reliably show one type of conduct.

Moreover, Polya's model is very helpful in the problem solving procedure as learners answer mathematics problems; however it is additionally exceptionally valuable in the educating process. For instance, as an educator review learners’ problem solving arrangement measure, he or she may see that the learners is working at devise a plan step of the procedure. For this situation, the educator could encourage the process by giving assistance at that stage, however ought not to engage with the completing the arrangement stage, which is straightaway (Ulandari et al., 2019).

**Problem Solving Approach and Mathematics**

Problem solving is an organized method in conceptualizing and understanding a given problem, planning systems to tackle the problem, and assessing the techniques
executed (Albay, 2019). In mathematics instruction, the term problem solving means to mathematical activities that can provide academic challenges to refining learners' mathematical perception and advancement. Such errands can spread learners' practical knowledge, develop their ability to reason and impart arithmetically, and get their advantage (Abdullah et al., 2010).

Mwelese and Wanjala (2014) showed that mathematics is a main sensible science whereupon different sciences like Chemistry, Physics, Biology and Geography depend. 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 problem solving comprises the center of arithmetic educational programs, as it is a significant part of instructive projects and delivering people who are fit for problem solving of mathematical training. Likewise, Cifarelli et al. (2010) demonstrated that the writing on numerical problem solving is clashed in its meanings of calculated solution of problem. As, question answering has been utilized with numerous implications that go from operative repetition activities to doing arithmetic as an expert.

The basic goal of mathematics instructing and learning is to build up the capacity to tackle complex problems that learners experienced in actual time (Chang et al., 2012). In typical classroom instructing, the normal practice found in mathematics learning of pupils was that they were a lot of used to doing practices without full comprehension of the systems engaged with deduction and dissecting measure. Subsequently, when learners experienced a genuine problem, they could not make a difference the reasoning and breaking down abilities to tackle the problems. In mathematics, comprehension and moving of the information and abilities to another circumstance assume an essential job (Phuntsho & Dema, 2019).
Amalia et al. (2017) found that mathematics is one of the most inadequately instructed and thought about troublesome justifiable subject in elementary schools. Students’ lackluster showing in mathematics can be credited to components, for example, society see that mathematics is challenging, deficiency of qualified educators, shortage of math research center and scarcity of attraction and in teaching method. Moreover, the learners become inactive beneficiaries of data in a customary model of instructing. Each general public anticipates from its instructive framework that it causes the people to turn into a successful problem solver in their reality (Yuanita et al., 2018).

In the line of previous study Alejo and Escalante (2014) depicted the problems are generally partitioned into two kinds: routine and non-routine problems. Furthermore, they expressed that routine problems can likewise be called works out. An activity is an inquiry that tests the learner's information on what was as of late secured. They might be troublesome, however are rarely jumbling and they are like those learners who have just figured out how to illuminate (Brown & Chandrasekaran, 2014). Interestingly, non-routine problems cannot be addressed promptly and they dislike any problems they have tackled previously. These problems are regularly open-finished and in some cases cannot be tackled and require examination. For the most part, regardless of whether they are normal, numerical issues are characterized as orally introduced problem that involve math arrangements (Abdullah et al., 2014).

Leong (2013) revealed that mathematical challenging answering is regarded as demonstration of affecting current information to another circumstance. Learners, while tackling problems, consolidate mathematical ideas with mathematical activities and equations and apply them together. In addition, Ozcan (2016) examined this method during the process is the most testing task for learners. For instance, a pupil
who recognizes the region estimation equation of a quadrilateral can simply clarify a tricky that is focused on straightforwardly computing the region of a quadrilateral. On the other hand, while the learner wants to compute the region of a rectangular inside an original sort of inquiry, pupil may neglect to move earlier information to the main work and will be unable to compute the question.

In Problem solving approach, learning starts with an problem to tackle, and the question is presented so that the students need to increase new information before they can answer the question (Ajai et al., 2013). Similarly, utilizing suitable methods through problem solving is essential to increase problem solving abilities, and they cause to notice the way that utilizing these abilities is a significant aspect of learners' self-controlled insight proficiency. Furthermore, the revisions on this subject perceive self-regulated learning capacity as key to problem-solving capabilities (Socas & Hernandez, 2013).

Torio (2015) identified that algebra math as a subject is offered to first year secondary school as fundamental subject in mathematics. He additionally revealed that this subject fills in as the essential establishment in tackling problems in different mathematics subjects like Geometry and Trigonometry. Furthermore, this subject utilizes images, ordinarily letters of the script, to illustrate numbers or amounts and express broad connections that hold for all individuals from a predetermined set.

Algebra math is utilized as a device in problem solving in secondary institute; it can likewise be made conceivable in the elementary. It is thus that the current investigator arranged an instructional material covering the most troublesome area in mathematics combined with the operation of algebra math in problem solving. Variable based math has been perceived as a basic achievement in learners' arithmetic understanding. Though, it has been noticed that numerous learners made a genuine
obstruction in the arithmetical critical thinking and formal numerical system. In this way, there has been a phenomenal thought conducted to keeping an eye on learners’ difficulties in Algebra learning (Wang, 2015).

Radford (2014) characterized one of the principal augmentations among number juggling and polynomial math is a didactical cut. For instance, the learners face such conditions as $ax + b = cx + d$. Learners could effectively illuminate the condition as $ax + b = c$ utilizing inversion activity as taking away $b$ from $d$ and partitioning by $a$. This kind of condition was named by them as algebraic. So as to simplify such conditions, learners need to depend on a genuinely mathematical thought of working the obscure. Working the obscure expects learners to think systematically, regarding the obscure as though it is known. This vision provides a specific situation which entails the progress from math to polynomial math. Therefore, this necessity originates commencing the basic notion of variable based arithmetic.

In the elementary level, the subjects secured are unraveling direct conditions with one variable in several stages, calculating, investigating, polynomials and uncommon items that are the basics of polynomial arithmetic. The problem solving approach sees polynomial math principally as a methods for tackling problems that are figured in equations. The inquiry is the thing that estimation of the variable which assumes the part of an unknown; satisfy the necessary conditions (Socas & Hernandez, 2013). Problems involving fraction is the most challenging for learners. Those even university level learners have difficulty in tackling problems on fraction (Qudwatullathifah et al., 2019). Mogari and Chirove (2017) expressed that rational expressions were the basic challenges of second year secondary school learners. In the elementary level, the exhibition level of students in sane numbers was commonly low.
Torio (2015) demonstrated that problems including fraction is the most hard for learners. This was featured by the discoveries of Priya (2017) who found that those even university level learners have difficulty in tackling problems on fraction. Kolovou et al. (2011) expressed that rational expression were the basic challenges of second year secondary school learners. In the elementary level, the performance level of students in rational numbers was commonly low. Moreover, the problems selected in mathematics ‘course ought to be intriguing and applicable to the matters that pupils required in their day by day institute exercises. Accordingly, the algebraic information and abilities that learners acquire will be significant to utilize the information in various circumstances (Guven & Cabakcor, 2013). Students should be capable to apply diverse problem solving approaches and they should comprehend the significance of arranging, controlling and utilizing various techniques. As learners become active during the time spent problem solving and indication that their answer strategies are valued (Taspinar & Bulut, 2012).

Problem solving approach is an archetypal which concentrated on learners, creates dynamic and motivated expertise, problem solving abilities and wide information, dependent on the profound comprehension and problem solving (Okigbo & Osuafor, 2008). In those schoolrooms where problem solving approach is utilized for teaching progression, the learners assume substantially additional liability of their knowledge. They have developed self-directed students, and can keep on learning as long as they can remember (Perveen, 2010).

**Characteristics of Problem Solving Approach**

Hajric et al. (2015) decided that problem solving teaching approach permit dynamic support of students in the training phase bring about better accomplishments and generally learning outcomes. Problem solving approach is an instructional
strategy pointed toward planning students for real life settings. By expecting learners to solve problems, problem solving method improves learners’ learning results by advancing their capacities and abilities in applying information, tackling problems, involved logical reasoning, and individual coordinating their particular understanding (Jonassen, 2011).

Problem solving approach was actualized in clinical school programs during the 1950s just because, in light of learners’ inadmissible exhibitions because of the notice on retention of divided biomedical information. From that point forward, it has been altered and applied in different expert regions, among them in science and instruction started by a need to solve a valid issue (Yoon et al., 2014).

In addition, problem solving approach as an instructional approach dependent on constructivism is the theory that students develop their own knowledge by involving current proficiencies where process of cooperation and consideration are incorporated (Ajai et al., 2013). Similarly, PSA is an learner focused approach in which learners can have more prominent self-sufficiency to decide their adapting needs dependent on the problems they experience. In addition, PSA motivates learners to be the partners in the circumstance; they are bound to obtain responsibility for problem when they put forth the attempt to explore it. In this way, PSA improves self-directed learning in which learners expect most of the duty and responsibility for their own instruction. Moreover, PSA also includes learners in little gatherings to achieve learning goals, making learning communitarian and cooperative (Simamora & Saragih, 2019).

Motivation

The word motivation gets from the Latin expression movere which intends to move. Motivation is described as a complicated and multidimensional develop (Liu &
Lin, 2010). Motivation, as an overall idea, incorporates wishes, wants, needs, and interests, and it is a power that coordinates manner. This power influences the creature and guides it to act towards an objective (Iflazoglu & Hong, 2012). In addition, motivation has been characterized as an intellectual and full of feeling power that starts, continues and coordinates commitment practices, as a disguised process of development drawn from the person's encounters, discernments and understandings (Lee & Reeve, 2012).

Motivation, consequently, includes learners’ ability or wants to take part in their learning. Furthermore, motivation as a learner’s readiness, want, and instinct to contribute in, and be effective in, the teaching process (Awofala, 2016). Similarly, motivation as a person's craving to act specifically ways, or individual action. Learners' affective domain has been well known in the mathematics instruction system in a continuous endeavor to comprehend learners' learning attitude (Walter & Hart, 2009). In particular, upgrading learners' motivation in the mathematics classroom is a significant problem for educators and specialists, because of its connection to learners' conduct and achievement (Pantziara & Philippou, 2015).

**Intrinsic and Extrinsic Motivation**

Motivation manages the reasons why students become fascinated and respond to those occasions that clasp their concern. Learners' objective directions are more extensive psychological directions that learners have toward their learning and they replicate the purposes behind carrying out a responsibility (Kriegbaum et al., 2019). Motivation is distributed into two principle classifications: inward and outward. Intrinsic motivation is made by the inner intentions which happen in the learning development because of person’s interest, requirement for information, want to be adequate, and want to create (Tsankov, 2012).
Furthermore, intrinsic motivation is characterized like performing a task for individual innate satisfactions playing out an action for the partiality inborn in the movement instead of some outward and detachable outcomes bringing about an outside incentive or acknowledgment (Irvine, 2015). In the previous study of Liu and Lin (2010) expressed that inborn objective direction centers around the inward reasons why learners partake in an errand, similar to interest, self-advancement, or fulfillment. For instance; the most fulfilling thing for me in the course is attempting to comprehend the substance as altogether as could be expected under the circumstances. In addition, intrinsic motivation makes an individual substantially more liable to be propelled and achieve well instead of those that were extraneously roused, and intrinsic variables may build fulfillment, authoritative responsibility, and fulfillment (Stone et al., 2009).

On other hand, extrinsic motivations are the outer elements that influence learners all through the learning cycle. For this situation, the learners do not move in the direction of learning, yet to pick up the endorsement of their instructors or guardians (Mahadi & Jafari, 2012). In addition, extrinsic goal orientation apprehension about the outer reasons why learners take an interest in an assignment, similar to: cash, evaluations, or commendations from others. For instance; I need to do well in this class since it is critical to show my capacity to my family, companions, manager, or others. Also, competition is by and large extrinsic as it asks the actor to triumph and exhausted others, not to value the inherent remunerations of the development (Tohidi & Jabbari, 2012).

Furthermore, intrinsic motivation increases the customary peculiarity between pupils’ natural and outward inspiration to a more multifaceted alteration of extrinsic motivation. These various kinds of attention were found to lead learners to various
learning results (Pantziara & Philippou, 2015). Additionally, Ozcan (2016) explored that motivation's relationship with adverse or beneficial outcomes on mathematical basic reasoning report that individuals with sufficient intrinsic inspiration are not influenced by adverse external components formerly the knowledge proceeds; what the learners want the best, particularly at what time tackling difficulties that are not normal and that they have not understood previously.

**Self-Efficacy**

Motivation is described as an unpredictable and multidimensional build. Self-efficacy affirms that when learners accept that they can do well in the instructive settings, they feel certain, will in general make a decent attempt, endure more, and perform better (Wood, 2019). Self-efficacy for learning and execution indicate to the result about person's capacity to achieve the task, for instance; I trust I can get a brilliant evaluation in this course (Liu & Lin, 2010). In other words, learners' mathematical self-efficacy is the learners' confidence in their level, consensus, and quality of these learners in different exercises and settings in learning mathematics (Ramdass & Zimmerman, 2008). Psycharis and Kallia (2017) expressed that student motivation was intensely anticipated by self-efficacy. In this way, the learner's self-efficacy should be engaged intensely by the educator. Educators must discover approaches to improve learners' mathematical learning capacity and must stress self-efficacy by planning suitable learning.

**Control Belief of Learning**

Control beliefs uphold that learners who accept that they keep more individual control of their insight are required to improve and accomplish at more significant levels than learners who do not feel in control of their learning conduct (Stone et al., 2009). Moreover, control beliefs state to the learners' accept that their exertion would
prompt positive outcome, for instance; If I concentrate in a fitting way, at that point I will have the option to gain proficiency with the material in this course (Liu & Lin, 2010). In mathematics learning, learners' state of mind is a significant viewpoint. The pupil's belief framework about problem solving decides pupil accomplishment in answering the questions (Schoenfeld, 2013).

In the previous study of Tokan and Imakulata (2019), motivation and learning behavior are two significant factors in deciding learners' learning success. Learning motivation, both from the learners themselves, just as from outside, will decide learners' learning behavior. Winardi (2011) found that our behavior is commonly motivated by a longing to accomplish certain objectives. Also, Cambria and Guthrie (2010) exposed that the last succession of motivation is finishing an activity that can give fulfillment. Similarly, Pantziara and Philippou (2015) found that the significance of inspiration in mathematics training has been all around recorded. Motivation as a possibility to coordinate behavior that is incorporated with the framework which controls feeling.

**Task Value**

Task value mentions to the learner’s observation or the consciousness about the material or task as far as value, importance, or applicability. The achievement esteem is dictated by how the task or the space satisfies an individual's needs; it concerns the pertinence of an action to an individual's real self-idea. For instance; I figure I will have the option to utilize what I realize in this course in different courses (Liu and Lin, 2010). In the previous study of Alharthy and Aldhafri (2014), the utility worth concerns the helpfulness of an assignment as a way to accomplish objectives that probably would not be identified with the task itself. The intrinsic value is the prompt satisfaction one gets for doing a task. For instance, undergrads that do not
buckle down in a specific class are not really apathetic or unmotivated.

**Test Anxiety**

Test anxiety discusses mentions to the adverse feeling identified with proceeding test, for instance; I have an uncomfortable, distressed inclination when I get hold of test (Liu & Lin, 2010). Celik and Yildirim (2019) found that test anxiety is the unwanted response to the evaluation which is the problem faced by the students all over the world. In addition, the most important challenge is the achievement of highest level of academic performance which causes students to experience great stress and anxiety (Daud et al., 2013). Moreover, it is because during examination time, the students experience greater anxiety. This anxiety is called test anxiety, which influence the educational achievement of students due to inability to tackle the time of tests. Their performance is decreased because their inability to reflect on the information contained in the content is decreased and as a result their academic performance is decreased (Haseli, & Rezaii, 2013).

In the line of previous study, Chamberlain et al. (2011) stated that little anxiety is beneficial as it helps the students to become motivated and thus learn new material effectively but greater anxiety negatively affects the educational accomplishment of the learners. Furthermore, greater anxiety is associated with certain psychological symptoms before or during test such as restlessness, difficulty in concentration, muscle contraction, and abdominal pain. These symptoms have negative effects on the general life and professional growth of the (Amalu, 2017).

**Motivation and Self Determination Theory**

Motivation, an explanation that pushes individuals to carry on with a particular goal in mind, has been generally concentrated in the instruction field. As per Self Determination Theory (SDT), individuals are brought into the world with intrinsic or
natural interest and incentives in learning (Deci et al., 2017). This inborn intention in learning is suggested to as natural inspiration. Aside from inborn inspiration, outward inspiration learning for outside reasons, for example, motivations and scores and an inspiration feeling contemptible to put forth an attempt to learn exist too in any learning sequence (Roth et al., 2019).

Similarly intrinsic motivation can advance learning and improvement with no outside power. It has likewise been found to improve students' long lasting learning (Niemiec & Ryan, 2009). Then again, intrinsic motivation drives the student utilizing some outside sources. When the outer source vanishes, the degree of inspiration would diminish. In this manner, improving students' inborn motivation is vital (Deci et al., 2017). In light of SDT, the students' intrinsic motivation and inclusion in homeroom exercises will be expanded when their mental needs, including self-rule, fitness, and relatedness, are satisfied and educators can assume a key part in this scheme (Vibulphol, 2016). Moreover, Coccia (2018) reported that SDT starts with an investigation of the determinants of characteristic motivation and human propensity towards learning and imagination that help inspiration, execution, and prosperity of individuals in associations, contention and society.

Motivation and Expectancy Theory

Expectancy theory was designed by Vroom (1964) is accepted that there are connection between the measure of exertion put into an errand and the exhibition that can be accomplished from the undertaking and get recognition for the exertion and implementation (Suciu et al., 2013). This theory portrays that solid exertion will prompt better performance and lead to rewards. As indicated by Vroom, exertion, execution and natural appeal are interrelated to human motivation. This theory is more to outside rewards and acknowledgment (Cook & Artino, 2016). In addition,
Expectancy theory encourages the view that learners are motivated when they judge an undertaking as by one way or another significant. Likely, under this system described that task value beliefs appear to influence students' decisions, similar to the enlistment in future courses. At long last, accomplishment objective theory centers around objectives, as the reasons and purposes for participating in accomplishment tasks (Zhu & Leung, 2011).

**Problem Solving Approach and Students’ Motivation**

Problem solving approach upgrades learners' higher request thinking, self-coordinated learning aptitudes, and inspiration to learn. This inborn motivating part enhanced learners' passion to learn and supports their enthusiasm over the span of the learning. PSA learners reliably overtook customary learners on long period maintenance evaluations (Jonassen, 2011).

Ilter (2014) recognized that motivation is a coordinated structure which incorporates inward progression of people's very own objectives, convictions, needs and interests just as outer cycles. The achievement of PSA is formation of learner focused learning condition to create inspiration to succeed scholastically. Correspondingly, one of the most significant reasons for this learning approach is to expand learners' inherent inspiration and to pick up learning results of arithmetic by sorting out states of outside inspiration (Chiang & Lee, 2016). In this process, instructors ought to be facilitator, uphold materials, increment inspiration and get pertinent instructive encounters through critical activities (MacDonell, 2007). In other words, students were urged to associate socially with their friends and to share venture items by advancing their own thoughts. Because of these intelligent exercises, learners' contrarily characteristic motivation or outer weights, for example, disgrace, blame, nervousness, family responses, dread of disappointment or low inspiration can
be eradicated. Consequently, learners can arrange outer and inner states of a controlled and arranged consideration by completing such tasks (Argaw et al., 2016).

The constructivist approaches lead to build scholarly inspiration to create psychological aptitudes in a wide assortment in class interest on science. Since constructivist approaches hold guarantee for expanding both learners achievement and motivation. One of the most mainstream approaches under the shelter of constructivist learning strategies is problem solving approach (Walker et al., 2013). PSA conditions not just guarantee learners to feel themselves as the proprietor of a property in a venture, yet in addition make higher motivation academically (Chu, & Hung, 2015). Similarly, social constructivist theories consolidated the issues of motivation in the socio constructivist viewpoint on getting the hang of, perceiving the nearby relationship between intellectual, persuasive, and emotional elements in learners' learning. Appropriately, students' personality exposes their requirements, their qualities, and their convictions which are communicated through their feelings (Pantziara & Philippou, 2015).

Tsankov (2012) expressed that educating of mathematics gives the students getting aptitudes and logical information required for sensible examination. The appropriation of different learning settings, learning and encouraging techniques just as evaluation rehearses animates learners' advantage and motivation for learning. Also, learners' enthusiasm to consider and learn mathematics and achievement in mathematics is as yet declining; the current discussion is to decide the most ideal manner by which learners learn mathematics. Thus, PSA is an instructional technique that may adequately expand students' motivation and maintenance of data as they effectively utilize basic deduction abilities to solve problems (Darma, 2018).
Academic Achievement

Academic achievement is a depiction of execution results that show the level which the learner has achieved explicit learning objectives and exhibits skill in extracurricular exercises (Schwinger et al., 2014). Bloom’s (1956) taxonomy is one of the most seasoned and most recognizable classifications for distinguishing the nature of learning results (Tuna & Kacar, 2013). This systematical classification depicts the significant regions that contain lower-request (information, understanding, application) and higher request thinking aptitudes (Alamri, 2019). Academic achievement was once thought to be the most significant result of formal instructive encounters and keeping in mind that there is little uncertainty regarding the indispensable jobs such accomplishments play in understudy life and later (Bhat, 2013).

Problem Solving Approach and Students’ Achievement

Malik et al. (2010) found that one of the principal attainments of instruction is to empower learners to utilize their insight in problem solving. Problem solving is an approach which defends an extensive scope of intellectual capacities. Learners ought to acknowledge what and why they are doing, and know the qualities of these procedures, so as to comprehend the approaches totally and have the option to choose proper ones (Dunlosky et al., 2013). Usman and Sule (2017) expressed that the introduction to problem solving approaches that students get could assist them with improving their achievement, increment their enthusiasm for a subject, and change learner mentalities towards learning.

Similarly, Caprioara (2015) characterized problem solving as an objective coordinated conduct that requires a proper mental portrayal of the issue and the ensuing utilization of specific techniques or procedures so as to move from an
underlying, present status to an ideal objective state. Moreover, Chew et al. (2019) recommended that problem solving procedure can be instructed and learned. Furthermore, the objective of the implementation of problem solving techniques in instructing is to allow understudies to utilize the abilities they have learned in handling pertinent problems.

Codina et al. (2015) study demonstrated that maximum learners are unskilled sufficient in gaining information freely and in the utilization of this information to tackle regular daily existence problems. During the time spent training problem solving is appropriate way to deal with include learners in higher request thinking tasks like investigation, synthesis and assessment. In the expressions of Ulva (2017), problem solving additionally includes a learner's readiness to acknowledge demands. The leaners who can effectively take care of an subject have great understanding aptitudes, can investigate different cases, can distinguish significant parts of an problem, can gauge and make analogies and endeavor attempting different systems.

Besides, Celik (2018) demonstrated that instructing strategies greatly affect students' mentality to gain proficiency with a subject. That is the reason it is picked to discover the impacts of problem solving instructing on learners' achievement towards mathematics learning since learners would not have the option to learn numerical ideas appropriately without having reasonable degree of achievement towards mathematics. In addition, impacts of mandate and non-order critical thinking on accomplishment of learners in a formative mathematics track; the outcome was that accomplishment turns out to be surer after guidance (Gok & Silay, 2010).

Similarly, Fernandes et al. (2011) investigated mathematics instructors’ idea around problem solving. Moreover, they referenced that arithmetic educators' groups were created through the point of setting up a principle of critical thinking relating to
center institute arithmetic instructors. The way of life might be conveyed over into such instructors' classroom. Torio (2015) found that dominant part of the pupils learn best through dynamic problem solving, posing inquiries and applying mathematics in close to home and day by day life.

**Relationship between Motivation and Academic Achievement**

Motivation as psychological, enthusiastic and social determinants of learner interest in instruction and responsibility (Sivrikaya, 2019). In other words, motivation is through in what way individuals are preserved and however they believe around the action they organize. Furthermore, motivation is a principal way for academic achievement and it contains internal and external variables that invigorate prerequisite and strength in persons to remain persistently fascinated and determined to subject (Celik et al., 2017).

Moreover, Durdukoça (2010) found that motivational views are simple to the school achievement of learners as they support to select the level to which learners may reflect, esteem, invested and display eagerness for the activity. For example, self-efficacy influences in what way pupils reflect and implement. Previous study Karaguven (2012) expressed that the student thinks about that the individual can achieve the showing exercises and objectives to be acknowledged with a specific exertion and trouble. Hence, it can contrarily influence the learner's motivation in occasions as simple as exceptionally troublesome occasions. Then again, if a learning action will give an advantage to the learner, the pupil considers this to be as important and puts forth attempts. Therefore, particularly concerning learners, motivation for educational achievement is critical. Similarly, motivation entities are animated to positively achieve a task, accomplishing an aim in its works (Amrai et al., 2011).

However, motivation is additionally done as scholarly contribution that is the
greatest persuasive in learner execution with each factor (Zheng, 2014). Likewise, a prosperous learner is a informally satisfactory, objective situated then inside propelled learner who may adequately adjust the societal and scholarly part of the institute (Sivrikaya, 2019). Sharma and Sharma (2018) announced that motivation for academic achievement is attributed to execution that promotes understanding and accomplishment. Furthermore, motivation for academic achievement is such an obligatory propensity to performing a duty viably in a particular situation and measuring the presentation unexpectedly. Hence, problem solving approach causes the educator to create enthusiasm towards mathematics among the learners.

In the line of previous study Vidrine et al. (2013) revealed that motivation and problem solving upgrade the person's effectively achievement and keep up the self-control. In the line of previous study Chiang and Lee (2016), student's motivation encourages academic accomplishment and has a positive relationship with learning commitment and achievement. In the line of previous study Tokan and Imakulata (2019), motivation is not just significant in urging learners to learn, yet additionally in helping learners in achievement. Amrai et al. (2011) announced a progressive and noteworthy connection between motivation and academic achievement in particular investigation.

Many researches Mwelese and Wanjala (2014); Argaw et al. (2016) work have been done in mathematics on the practicality of problem solving technique for educating. Results of previous study Usman and Ikechukwu (2018) showed that learners learn better by building answers for open-finished, complex, and tricky exercises with schoolmates, as opposed to listening inactively to addresses. Furthermore, such exercises require some serious energy yet can be amazingly compensating when learners achieve their learning objectives. Kotsopoulos and Lee
(2012) directed a naturalistic investigation of chief capacity and mathematical problem solving. They additionally found that learners' advancement in problem solving while they participate in an acquainted investigation of the complication.

Mannamaa et al. (2012) verified intellectual relates of arithmetic abilities on learners. Thus, the outcomes indicated that vocal thinking were utmost reliably connected with arithmetic knowing and problem solving spaces. Capraro et al. (2012) examined the impact of reading and improved word problem solving. They also found that outcomes focused on that educators need to contemplate learners determining an answer and more regarding encouraging learner's use of the intellectual segments of reading and mathematics. Phuntsho and Dema (2019) found that learners instructed through problem solving method accomplished superior relative to entities educated through customary technique. Furthermore, they also verified that the noteworthy difference between the achievement levels was because of problem based learning.

In the previous study of Voyer (2011), execution in mathematical problem solving as an element of perception and mathematical aptitudes found that students who give more noteworthy significance to situational data in a problem have more prominent achievement in solving the problem. In the previous study of Craig (2016) explored classification and investigation of informative writing in mathematics. Besides, they found that the plan effectively watched positive changes over the test time frame in student's degree of commitment with the mathematical material. In line with the previous study, the study of Gok & Silay (2010) revealed that educating of the problem solving methods is more operative than conventional instructing. Also, Behlol et al. (2018) on uses of problem based strategy during instructing arithmetic at rudimentary level found that learners educated by PSA held the topic more because of more noteworthy comprehension than the students educated by outdated technique.
Similarly, the investigation of Parveen (2010) found that the learners educated by the problem solving approach indicated much better achievement contrasted with the benchmark group which was instructed by the informative technique. Moreover, Ali et al. (2010) in his investigation on the impact of utilizing problem solving technique in instructing arithmetic on the learners’ accomplishment of mathematics stated that there was noteworthy distinction in the practicality of customary instruction strategy and problem based technique in educating of arithmetic at elementary level. However, the theoretical framework of this study is related to George Polys’ heuristics steps of problem solving approach.
Theoretical Framework of the Study

George Polya’s Steps of Problem Solving Approach Model

Students learned through Problem Solving Approach

Motivation

Academic Achievement Test

Students learned through with Traditional Method

Motivation

Academic Achievement Test

Treatment Duration- sixteen weeks

Pre-test

Post-test

Figure 1.2: Theoretical Framework
CHAPTER III

Methodology of the Study

This chapter involves the research design and background where the intervention was accomplished. It discusses sample choice with population of the study. Furthermore, Improvement and approval of research instruments which were utilized for reason for data collection is additionally talked about in this section. However, a short review of the experiment inclined to the experimental group is examined here.

Research Design

In the present study, researcher has utilized a quantitative research technique to examine at the effect of Problem Solving Approach on students' motivation and their academic achievement in mathematics on a sample of pupils of class VIII in a public school. There was one independent variable (problem solving approach) and two dependent variable (learners' motivation and learners' academic achievement) in mathematics. A quasi-experimental design that was entitled in research volumes as pre-test post-test control group design was used in this study (Mills & Gay, 2019). The experiment was conducted for a period of sixteen weeks.

Table 3.1

Symbolic Depiction of Experimental Design

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>O</th>
<th>X</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>O</td>
<td>C</td>
<td>O</td>
</tr>
</tbody>
</table>

Where Pre-test=O=Post-test, Treatment =X, Control group= C.

Hence, the pre-test used to generate the knowledge baseline of the students as well as the academic uniformity of the two groups before the beginning of the experiment. The post-test accustomed determine the motivation and academic achievement of students within the two groups after the application of treatment.
Population of the Study

The target population of this study was consisted of all elementary school students of eighth grade in district Lahore. The elementary school students of eighth grade enrolled in the current year 2018-2019 was considered the accessible population of this study.

Sample of the Study

The sample of this research comprised of intact groups of apprentices of class VIII learning in a public school of Lahore. One public sector school, Government Girls High School, selected conveniently. These 64 class VIII apprentices were already reading in two sections specifically, section A and section B (32 each intact classes). Both of these sections were randomly assigned as an experimental group and the other group was reflected as control group.

![Figure 3.1: Sampling Design](image-url)
Research Instruments

Two research tools were applied in this study. First was questionnaire of Mathematics Motivation Scale (MMS) for learning mathematics and other was academic achievement test.

Mathematics Motivation Scale (MMS)

The standardized questionnaire MMS (Mathematics Motivation Scale) was adapted to measure students’ motivation towards mathematics. This instrument MMS was developed by Liu and Lin (2010) and they permitted to utilize this instrument in this study (Appendix K). Mathematics Motivation Scale (MMS) contained of several factors, intrinsic goal orientation (IGO), extrinsic goal orientation (EGO), task value (TV), control beliefs of learning (CBL), self-efficacy (SE) and test anxiety (TA). This questionnaire of motivation comprise of close ended statements dependent on five-point Likert scale. Reactions of everything were allotted loads; 5 for strongly agree, 4 for agree, 3 for normal, 2 for disagree and 1 for strongly disagree. Data was directed to quantify alteration in the pupil’s motivation for learning mathematics under MMS two times at beginning (pre-test) and completion of treatment (post-test).

Validation of MMS Scale

At first this scale involved 36 explanations having 6 assertions for estimating IGO, 6 affirmation for EGO, 6 for TV, 6 for CBL, 5 for SE and 7 statements for TA. A pilot study was done for ensuring of instrument. MMS was translated into Urdu language by the specialists’ views of Urdu teachers so that learners can easily understand this (Appendix D). Moreover, this scale was pilot tested on 300 schoolgirls of eighth class of the similar school where the achievement test were conducted for piloting. Factor analysis was utilized to check the construct validity of the questionnaire (MMS) and 300 is an appropriate example size of any scale (Field, 2005).
Factor Analysis of Mathematics Motivation Scale

Ledesma and Mora (2007) have defined that factor analysis is a technique commonly employed in social sciences. An instrument’s validity and reliability are generally tests to assess and affirm the adequacy of any measurement scale and are utilized in front of directing any analysis of statistical nature (Hair et al., 2006; Shalender, 2017). Validity of the instrument ensures the level of research’s certainty (Hair et al., 2006). Validity is assembled as the construct and content validity. Content validity identified the level of idea representativeness through its related thing or markers (Cooper & Schindler, 2006). Confirmatory factor analysis was administered to confirm validity about every subscale of MMS.

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis confirms the factor structure of any measurement theory. CFA clarifies beginning measurement model fit situation of any idea. Marcoulides and Hershberger (1997) states that in CFA a researcher is confronted with effectively determined variables to be estimated and affirmed rather to be recognized in EFA (Hair et al., 2006).

Convergent Validity

Average Variance Extracted (AVE) is quantity to indicate the degree of convergence or the convergent validity (Hair et al., 2006) which shows the satisfactory convergent validity of each dimension. AVE can be calculated once factor loading exceeds (≥.5). AVE measures the percentage of communality variance among the items (Hair et al., 2006). The AMOS does not calculate the value of AVE, rather can be computed using MS Excel, the value of AVE can be measured using the formula given below.
\[ AVE = \frac{\sum_{i=1}^{n} \lambda_{i}^2}{n} \]

That is,

\( \lambda \) is the systematize factor loadings

\( n \) is the number of substances.

The worth of AVE >0.50 is recognized in place of adequate convergent validity of the scale. AVE greater than 0.5 is acceptable, however AVE values between 0.30-0.50 are also acceptable (Fornell & Larcker, 1981). Further, if CR is greater than 0.6 and AVE is less than 0.5, the convergent validity of the construct, yet possibly established (Malhorta & Dash, 2011; Fornell & Larcker, 1981).

**Construct Reliability (CR)**

Construct Reliability is another measure to assess convergent validity for the confirmation of factors. The value of CR cannot be assessed in AMOS. CR can be computed using MS Excel, the value of CR can be measured using the formula given below.

\[ CR = \frac{\left( \sum_{i=1}^{n} \lambda_i \right)^2}{\left( \sum_{i=1}^{n} \lambda_i \right)^2 + \left( \sum_{i=1}^{n} \delta_i \right)} \]

That is

\( \lambda_i \) is the weight of factors

\( \delta_i \) is the error of differences

**Item Consistency = factor load squared**

The value of CR ≥ 0.70 or between 0.6 to 0.7 is considered as acceptable reliability (Hair et al., 2006; Shalender, 2017).
Model Testing

The factor loading of each item of model is shown below. All variables are measured by multiple questions. If any item having factor loading >0.50 (Cua et al., 2001) will be included for further analysis. All the variable of EGO, TV, CBL and SE loading greater than 0.5, so further analyses, all items were included but the loading values of one item of IGO and TA is less than 0.40. So these two items were excluded from further analysis. The loading values are shown below.

Figure 3.2: Factor loading of items
Table 3.2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Items</th>
<th>Standardized Loadings</th>
<th>Item Decision</th>
<th>Cronbach’s Alpha</th>
<th>Composite Reliability</th>
<th>Average Variance Extracted (AVE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGO</td>
<td>M1</td>
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<td>Included</td>
<td>.92</td>
<td>.91</td>
<td>.66</td>
</tr>
<tr>
<td></td>
<td>M2</td>
<td>.43</td>
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<td></td>
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<td>Included</td>
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<td></td>
<td>M5</td>
<td>.80</td>
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<tr>
<td></td>
<td>M6</td>
<td>.83</td>
<td>Included</td>
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<tr>
<td>EGO</td>
<td>M7</td>
<td>.82</td>
<td>Included</td>
<td>.90</td>
<td>.89</td>
<td>.57</td>
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<tr>
<td></td>
<td>M8</td>
<td>.78</td>
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<td>M9</td>
<td>.67</td>
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<td>M12</td>
<td>.82</td>
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<tr>
<td>TV</td>
<td>M13</td>
<td>.62</td>
<td>Included</td>
<td>.89</td>
<td>.89</td>
<td>.57</td>
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<tr>
<td></td>
<td>M14</td>
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<td>M15</td>
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<td>M16</td>
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<td></td>
<td>M17</td>
<td>.71</td>
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<td></td>
<td>M18</td>
<td>.87</td>
<td>Included</td>
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<tr>
<td>CBL</td>
<td>M19</td>
<td>.83</td>
<td>Included</td>
<td>.84</td>
<td>.85</td>
<td>.50</td>
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<td>.80</td>
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<td></td>
<td>M21</td>
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<td>.89</td>
<td>.83</td>
<td>.51</td>
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<tr>
<td></td>
<td>M26</td>
<td>.73</td>
<td>Included</td>
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<td>M27</td>
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<td></td>
<td>M28</td>
<td>.82</td>
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<td></td>
<td>M29</td>
<td>.77</td>
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<tr>
<td>TA</td>
<td>M30</td>
<td>.74</td>
<td>Included</td>
<td>.86</td>
<td>.85</td>
<td>.50</td>
</tr>
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<td></td>
<td>M31</td>
<td>.83</td>
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<td>M32</td>
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<td></td>
<td>M36</td>
<td>-.04</td>
<td>Excluded</td>
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</tr>
</tbody>
</table>

The above table 3.2 shows the value of Standardized loadings, items decision (included/excluded), Cronbach’s Alpha, Composite Reliability and Average Variance Extraction (AVE). Systematized loadings >0.50 is acceptable, Cronbach’s Alpha
value >0.70 is satisfactory, in our variables values are within acceptable range. The value of Composite Reliability and AVE are additionally inside acknowledged range.

**Academic Achievement Test of Mathematics**

Academic Achievement Test of Mathematics (AATM) was assessed by utilizing objective and subjective type test. The scholarly achievement test was created, tending to the targets of the investigation, containing the units of mathematics with various intellectual levels, for instance; knowledge, comprehension and application, and so forth. AATM included 32 multiple choice items (MCQs) and 10 subjective type questions. Furthermore, assessment rule was arranged for objective outcome of the reactions of pupils in mathematics achievement assessment. For this purpose, answer key was prepared for checking 32 MCQs, representing 1.5 score for every right response of MCQs (Appendix H). On the other hand, subjective test or restricted response item was recorded by employing the rubrics (Appendix I) adapted from Punjab Examination Commission (PEC). Thus, total test contained 100 scores and the content validity of test was established by constructing table of specification.
<table>
<thead>
<tr>
<th>Units</th>
<th>Knowledge</th>
<th>Comprehension</th>
<th>Application</th>
<th>Total no. of items</th>
<th>Percentage of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factorization, Simultaneous Equations</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>10</td>
<td>31%</td>
</tr>
<tr>
<td>Fundamentals of Geometry</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>31%</td>
</tr>
<tr>
<td>Areas and Volumes</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>22%</td>
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<tr>
<td>Information Handling</td>
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<td>1</td>
<td>2</td>
<td>5</td>
<td>16%</td>
</tr>
<tr>
<td>Total no. of items</td>
<td>13</td>
<td>10</td>
<td>9</td>
<td>32</td>
<td>100%</td>
</tr>
<tr>
<td>Percentage of items</td>
<td>41%</td>
<td>31%</td>
<td>28%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MCQs = Multiple Choice Questions
Table 3.4

<table>
<thead>
<tr>
<th>Units</th>
<th>No. of questions</th>
<th>Marks for questions</th>
<th>Percentage of questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factorization, Simultaneous Equations</td>
<td>4</td>
<td>19</td>
<td>36%</td>
</tr>
<tr>
<td>Fundamentals of Geometry</td>
<td>1</td>
<td>5</td>
<td>10%</td>
</tr>
<tr>
<td>Areas and Volumes</td>
<td>3</td>
<td>16</td>
<td>31%</td>
</tr>
<tr>
<td>Information Handling</td>
<td>2</td>
<td>12</td>
<td>23%</td>
</tr>
<tr>
<td><strong>Total no. of items</strong></td>
<td><strong>10</strong></td>
<td><strong>52</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

RRI= Restricted Response Items

**Validation of Academic Achievement Test**

The academic achievement test of mathematics was evaluated through four qualified mathematics instructors for correctness of substance and language (Appendix B). In the first phase, pilot testing was done in the first week of January 2019 (200 students) in two government girls schools. As Gay et al. (2012) indicated that pilot testing is used to find out the deficiencies and omissions. Hence, defendants in the pilot testing were the learners of class eighth who had read the content. Item analysis was applied to decide Difficulty Level and Discrimination Power of every entity.

Items with a discrimination index above 0.20 and difficulty index ranging from 0.20 to 0.70 were encompassed in the experiment. Items with discrimination index of 0.40 and above are very good ones, items with discrimination index of 0.20 to 0.39 are moderate and 0.19 and below are not acceptable as they are showing very low discrimination value. Likewise, difficulty index of items having four distractors should be from 0.26 to 0.75 which shows optimum difficulty, 0.76 to 0.90 are easy item and 0.11 to 0.25 are difficult while 0.10 and below shows very difficult item (Ebel & Frisbie, 1991).
As, Kubiszyn and Borich (2007) suggested that good items to be measured in the test. On the basis of these results, item no. 4, 9, 15, 17, 33 and 37 were reflected troublesome in place of their standards ranged 0.11 to 0.25 and discrimination power of such values are slighter, thus certain questions were excluded. One item 12 had high difficulty level however positive discrimination index. So, this item was not excluded because it measured application level of cognitive domain. Hence, total 32 items were confirmed for test to whom “Difficulty level” and “Discrimination power” is presented in table 3.5:
Table 3.5

*Item Analysis of Objective Type Test (MCQs) in Academic Achievement Test of Mathematics based on Classical Theory*

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Difficulty Index</th>
<th>Discrimination Index</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>0.54</td>
<td>0.64</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q2</td>
<td>0.65</td>
<td>0.74</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q3</td>
<td>0.47</td>
<td>0.38</td>
<td>Moderate</td>
</tr>
<tr>
<td>Q4</td>
<td>0.24</td>
<td>0.15</td>
<td>Poor</td>
</tr>
<tr>
<td>Q5</td>
<td>0.54</td>
<td>0.602</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q6</td>
<td>0.53</td>
<td>0.41</td>
<td>Good</td>
</tr>
<tr>
<td>Q7</td>
<td>0.45</td>
<td>0.39</td>
<td>Moderate</td>
</tr>
<tr>
<td>Q8</td>
<td>0.64</td>
<td>0.34</td>
<td>Moderate</td>
</tr>
<tr>
<td>Q9</td>
<td>0.17</td>
<td>0.13</td>
<td>Poor</td>
</tr>
<tr>
<td>Q10</td>
<td>0.57</td>
<td>0.42</td>
<td>Good</td>
</tr>
<tr>
<td>Q11</td>
<td>0.51</td>
<td>0.38</td>
<td>Moderate</td>
</tr>
<tr>
<td>Q12</td>
<td>0.18</td>
<td>0.19</td>
<td>Poor</td>
</tr>
<tr>
<td>Q13</td>
<td>0.62</td>
<td>0.58</td>
<td>Good</td>
</tr>
<tr>
<td>Q14</td>
<td>0.52</td>
<td>0.69</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q15</td>
<td>0.87</td>
<td>0.18</td>
<td>Poor</td>
</tr>
<tr>
<td>Q16</td>
<td>0.51</td>
<td>0.64</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q17</td>
<td>0.15</td>
<td>0.21</td>
<td>Poor</td>
</tr>
<tr>
<td>Q18</td>
<td>0.58</td>
<td>0.49</td>
<td>Good</td>
</tr>
<tr>
<td>Q19</td>
<td>0.55</td>
<td>0.54</td>
<td>Good</td>
</tr>
<tr>
<td>Q20</td>
<td>0.57</td>
<td>0.70</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q21</td>
<td>0.53</td>
<td>0.62</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q22</td>
<td>0.58</td>
<td>0.49</td>
<td>Good</td>
</tr>
<tr>
<td>Q23</td>
<td>0.55</td>
<td>0.61</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q24</td>
<td>0.56</td>
<td>0.70</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q25</td>
<td>0.50</td>
<td>0.56</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q26</td>
<td>0.62</td>
<td>0.55</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q27</td>
<td>0.51</td>
<td>0.42</td>
<td>Good</td>
</tr>
<tr>
<td>Q28</td>
<td>0.65</td>
<td>0.78</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q29</td>
<td>0.41</td>
<td>0.38</td>
<td>Moderate</td>
</tr>
<tr>
<td>Q30</td>
<td>0.49</td>
<td>0.52</td>
<td>Good</td>
</tr>
<tr>
<td>Q31</td>
<td>0.54</td>
<td>0.41</td>
<td>Good</td>
</tr>
<tr>
<td>Q32</td>
<td>0.58</td>
<td>0.67</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q33</td>
<td>0.25</td>
<td>0.17</td>
<td>Poor</td>
</tr>
<tr>
<td>Q34</td>
<td>0.58</td>
<td>0.72</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q35</td>
<td>0.57</td>
<td>0.69</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q36</td>
<td>0.49</td>
<td>0.36</td>
<td>Moderate</td>
</tr>
<tr>
<td>Q37</td>
<td>0.15</td>
<td>0.07</td>
<td>Poor</td>
</tr>
<tr>
<td>Q38</td>
<td>0.62</td>
<td>0.66</td>
<td>Excellent</td>
</tr>
</tbody>
</table>
In the review of the subjective type test (restricted response items), item analyses was established on Classical Theory. Furthermore, in subjective type questions of mathematics, 4 items were originated in the range of poor quality. Item no. 34 (b), 36(a), 38(b) and 39(b) were deliberated tough while their standards ranged 0.11 to 0.25 and discrimination power of such items were below 0.19 that displayed these items have low discrimination power, so such items were excluded. However, total 10 items were confirmed for test to whom “Difficulty level” and Discrimination power” is presented in table 3.6:
Table 3.6

*Item Analysis of Subjective Type Test in Academic Achievement test of Mathematics based on Classical Theory*

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Difficulty Index</th>
<th>Discrimination Index</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q33(a)</td>
<td>0.54</td>
<td>0.48</td>
<td>Good</td>
</tr>
<tr>
<td>Q33(b)</td>
<td>0.68</td>
<td>0.82</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q34(a)</td>
<td>0.57</td>
<td>0.78</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q34(b)</td>
<td>0.17</td>
<td>0.08</td>
<td>Poor</td>
</tr>
<tr>
<td>Q35(a)</td>
<td>0.69</td>
<td>0.65</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q35(b)</td>
<td>0.42</td>
<td>0.47</td>
<td>Good</td>
</tr>
<tr>
<td>Q36(a)</td>
<td>0.21</td>
<td>0.14</td>
<td>Poor</td>
</tr>
<tr>
<td>Q36(b)</td>
<td>0.54</td>
<td>0.68</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q37(a)</td>
<td>0.58</td>
<td>0.78</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q37(b)</td>
<td>0.69</td>
<td>0.80</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q38(a)</td>
<td>0.59</td>
<td>0.72</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q38(b)</td>
<td>0.24</td>
<td>0.12</td>
<td>Poor</td>
</tr>
<tr>
<td>Q39(a)</td>
<td>0.6</td>
<td>0.72</td>
<td>Excellent</td>
</tr>
<tr>
<td>Q39(b)</td>
<td>0.19</td>
<td>0.10</td>
<td>Poor</td>
</tr>
</tbody>
</table>

In the next phase, academic achievement test of mathematics was piloted on 100 students. Reliability of the inquiry form was established by Cronbach alpha reliability ($r = 0.85$), that makes it reliable sufficient to be applied in evaluating pupils’ achievement scores in mathematics (Linn & Grunland, 2000).

**Planning of Lesson Plans for Problem Solving Approach in Experimental Group**

The lesson plans for this study were planned through accessing textbook of mathematics class VIII printed by Punjab textbook board, Lahore, in discussion by subject experts of mathematics (Appendix D). The lesson plans were completely highlighted on mathematical background and SLOs of transcript assessable. Educating substantial requisite for the instructing was recognized. Mathematics tools, graphs, white board, pointer, dust cloth, Audio visual aids and textbook of mathematics for class eighth were used in the problem solving procedure.
Table 3.7

Topics Designated for the Experiment

<table>
<thead>
<tr>
<th>Unit# 6</th>
<th>Factorization, Simultaneous Equations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise 6.1</td>
<td>• Remember the formulas:</td>
</tr>
<tr>
<td></td>
<td>(a ± b)^2 = a^2 ± 2ab ± b^2 and apply them to solve problems</td>
</tr>
<tr>
<td>Exercise 6.2</td>
<td>• Factorization expression the following terms:</td>
</tr>
<tr>
<td></td>
<td>i. Type Ka + kb + kc</td>
</tr>
<tr>
<td>Exercise 6.3</td>
<td>ii. Type ac + ad + bc + bd</td>
</tr>
<tr>
<td>Exercise 6.4</td>
<td>iii. Type a^2 ± 2ab + b^2</td>
</tr>
<tr>
<td>Exercise 6.5</td>
<td>iv. Type a^2 − b^2</td>
</tr>
<tr>
<td>Exercise 6.6</td>
<td>v. a^2 ± 2ab + b^2 − c^2</td>
</tr>
<tr>
<td>Exercise 6.7</td>
<td>• Recognize the Formulas:</td>
</tr>
<tr>
<td></td>
<td>▪ Formula (a ±b )^3 = a^3 ±3ab ( a ± b) ±b^3</td>
</tr>
<tr>
<td>Exercise 6.8</td>
<td>• Simultaneous Linear Equations</td>
</tr>
<tr>
<td></td>
<td>• Recognize simultaneous linear equations in one and two variables.</td>
</tr>
<tr>
<td>Exercise 6.9</td>
<td>▪ Solve simultaneous linear equations using</td>
</tr>
<tr>
<td></td>
<td>▪ Technique of comparing the coefficients</td>
</tr>
<tr>
<td></td>
<td>▪ Technique of eradication by substitutions</td>
</tr>
<tr>
<td>Exercise 6.10</td>
<td>• Solving actual existence problems including two simultaneous linear equation in two variables</td>
</tr>
<tr>
<td>Exercise 6.11</td>
<td>• Elimination of a Variable From Two Equations</td>
</tr>
<tr>
<td></td>
<td>▪ Elimination of variable from both equations by substitution</td>
</tr>
<tr>
<td>Exercise 6.12</td>
<td>▪ Elimination of a movable from both equations by use of formulations</td>
</tr>
</tbody>
</table>

Unit# 7  Fundamentals of Geometry

Exercise 7.1 | • Describe Equivalent outlines |
|           | • Demonstrate concluded numerals the subsequent goods of equivalent outlines: |
|           | • Draw a transversal to intersects dual equivalent shapes and demonstrate analogous slants. |
| Exercise 7.2 | • Describe Polygon. |
|           | • Demonstrate the assets of a parallelogram. |
| Exercise 7.3 | • Determine an argument relating in the inside and outside of a sphere |
|           | • Define the positions; segment and triad of domain. |

Unit # 9  Areas and Volumes

Exercise 9.1 | • Describe the Pythagoras formula and provide its casual evidence. |
| Exercise 9.2 | • Define and use Hero’s formulation to discover the ranges of trilateral and rectangular areas. |
| Exercise 9.3 | • Discover the outward space and volume of a domain. |
Exercise 9.4

- Explain the outward space and volume of a shaft.
- Find the actual world questions containing outward space and volume of a domain and pinecone

Unit # 12 Information Handling

Exercise 12.1

- Describe frequency Distribution
- Make frequency table.

Exercise 12.2

- Define gradation of central tendency.
- Compute mean, median and mode.

Above table 3.7 presented the units designated for the goal of giving treatment to interventional group as indicated by the SLOs referenced in transcript material. The phases in substantial expansion of exemplary lesson are given below:

- The subjects from particular units whose problem solving teaching approach can be properly refined were recognized from mathematics transcript work.

- The researcher through the discussion of aristocrats getting experienced in M.Sc. Mathematics prepared a standard lesson from each unit, i) Factorization and Simultaneous Linear Equations, ii) Fundamentals of Geometry, iii) Areas and Volumes and iv) Information Handling. These model lesson plans (Appendix J) were additional discoursed with a board of mathematics’ professionals (Appendix C) to make sure the depiction of the ideas of the subjects with appropriate opinion.

- Moreover, every lesson plan was partitioned into 6 sections. Section 1 comprised of introductory data, time of period, name of school, topic to be instructed. Section 2 was comprised of the objective of the study. Section 3 comprised of setting up relationship of past information with presentation and announcement of the topic. Section 4 depended on Polya's heuristic steps of problem solving method (comprehend the problem, formulate a plan, do design and evaluate the results). Section 5 was committed to class work and section 6 to schoolwork. In the light of these plans, model lessons were developed.
Hence, Mathematics Punjab Textbook Board, Lahore for grade VIII is designed in order to continue the step of continuing improvement of views in mathematics as representative by National Curriculum 2006 for mathematics I to XII. This book is fully aligned with the National Curriculum 2006 and it has total 12 units of mathematics. In this study, the content covered by using Polya’s steps of problem solving teaching process for the period of sixteen weeks.

**Intervention**

Experiment was conducted for a period of sixteen weeks in the wake of receiving consent from school headmistress (Appendix A). Sectors were assigned as interventional and conventional group randomly. The experiment was directed in the typical school time frames as per the school schedule. At the start of the experiment, the applicants of interventional and conventional group were given the pre-test. Both groups were given questionnaire of Mathematics Motivation Scale (MMS) in order to check the motivation level at start (pre-test) of experiment. Academic Achievement Test from eighth grade mathematics textbook units (6th, 7th, 9th and 12th) of Factorization Simultaneous Equations, Fundamentals of Geometry, Areas and Volumes and Information Handling were also 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.

Moreover, on the basis of previous knowledge pretest of interventional and conventional group was administered to check initial equivalence. The interventional group was instructed with problem solving method. Though, the conventional group was instructed through formal traditional system. There are fourth steps of Problem Solving Approach (PSA) which was helped the students to become better problem solver. First step of PSA was to understand the problem, second step was to devise a
plan, third step was to carry out the plan, and fourth step was to evaluate the results. The first step in PSA instruction was to understand the problem (description). In this step, students were instructed that they are going to learn the necessary underlying mathematical concepts. Next, the step of problem solving approach was described in the classroom. Students were understood the vocabulary and symbolization used in the tricky in mathematics. For example; what kind of a question right? What is being inquired? What do the terms mean? Is there further data required? What is identified or obscure? Moreover, students were rephrased the problem in their own words. Furthermore, they were written explicit instances of the situations given in the question. Moreover, they were perceived why the unique approach was significant and in what manner it could support them.

The second step by the use of Problem Solving Approach in mathematics was to devise a plan (planning or thinking time). In this step, students were the problem aside for a while after understanding. Afterward, students were given time to start somewhere and to try something, how did they tackle the problem? Their subconscious mind may keep working on it. They were thinking different things which may assist them with staying unwind, adaptable and inventive as opposed to getting nervous, baffled, and compelled to tackle the problem. In addition, they were used possible strategies: For example; Magnetism images, pick supportive terms for factors or obscure, be efficient, measure a less complex adaptation of the question, supposition and check, investigation, speculation and assessment, and search for an examples and made record. Moreover, the pupils were involved with the way toward intuition and problem solving while at the same time going up against with the problems. Learners created thinking aptitudes and critical thinking capacities, for example, addressing, arranging problematic discovering exercises, and analyzing subject.
The third step in problem solving approach was to *carry out the plan (implementation)*. During this step students were shown persistence on chosen plan. After that, if the plan was not able to produce desired results in a reasonable time frame then they were chosen another plan. Finally, students participated in the *evaluating plan (checking)* step of PSA model. During this step, students were assisted in choosing real solutions to the problem. In this way, Polya’s steps of heuristic method were reflected for PSA of educating mathematics. Teacher was guided the apprentices to arrive at result through inquiries. In the first place, the teacher was solved the questions on white board with energetic involvement of pupils by way of successive inquiries. Toward the finish of exercise, pupils were identified comparable problems to do in the class. Learners were associated with some composed movement. Instructor was likewise controlling the pupils in their group work to response the queries. On the completion of intervention, post-test was administered to both group, one group after giving the treatment and to other group without giving any treatment. Both groups were given questionnaire of Mathematics Motivation Scale in order to check the motivation level after this experiment.

**Data Collection**

Researcher taken pre-test prior the stage of experiment. Data were taken during the pre-test and post-test from both groups on students’ motivation and their academic achievement in mathematics. Four units from the recommended manuscript of mathematics for class VIII, printed in Punjab Textbook Board Lahore, were educated by aimed intervention. The researcher herself instructed the both groups. Students of the interventional group were instructed with the Polya’s steps of problem solving approach. The conventional group was educated with the formal tradition way. Both groups were used the same textbook, following the same curriculum content under the guidance of the researcher.
Data Analysis

Data was analyzed by using descriptive (mean score) and inferential statistics (t-test). The mean score of the interventional and conventional groups were equated through consecutively independent sample t-test and paired samples t-test to examine the likely differentiation among both groups (interventional and conventional group) during expression of learners’ motivation and academic achievement towards mathematics. In addition, Pearson ‘r’ test was employed to identify the relationship in learners’ motivation and academic achievement in mathematics.
CHAPTER IV

DATA ANALYSIS AND INTERPRETATION

This chapter discusses the analysis and interpretation of data. For this purpose, inferential analysis techniques were applied according to the corresponding hypothesis. The results of this section investigate the problem solving approach’s effect on students’ motivation and academic achievement. To identify mean scorers difference of students’ motivation and academic achievement who had taught through problem solving approach and traditional method independent t-test was employed. To investigate difference in mean scores of pretest and posttest scores of students who had been taught through problem solving approach and traditional method paired t-test was employed. To identify the relationship in student’s motivation and academic achievement for learning mathematics Pearson ‘r’ was used. Findings of experiment are being discussed in this chapter.

Ho1.1 There is no significant effect of Problem Solving Approach on students’ motivation in mathematics at elementary level.

Ho1.2 There is no significant difference in the pre-test post-test motivation means score of experimental group.
Table 4.1

Comparison of experimental group’s pre-test post-test motivation scores by Paired sample t-test

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>32</td>
<td>108.97</td>
<td>5.57</td>
<td>31</td>
<td>-28.67</td>
<td>.000*</td>
</tr>
<tr>
<td>Post-test</td>
<td>32</td>
<td>137.94</td>
<td>2.49</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

It is perceived from table 4.1 that at the p value (p=.000<0.05) noteworthy distinction was established in the test scores interventional group’s pretest (M=108.97) and posttest (M=137.94). Therefore, there is no significant distinction in the pretest posttest motivation tests score of interventional group, was negated. It showed that learners educated by problem solving approach getting greater responses of motivation as contrasted to conventional method.
Ho1.3 There is no significant difference in the pre-test post-test motivation means score of control group.

Table 4.2

*Comparison of control group’s pre-test post-test motivation scores by Paired sample t-test*

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>32</td>
<td>108.88</td>
<td>4.37</td>
<td></td>
<td>31</td>
<td>.145</td>
</tr>
<tr>
<td>Post-test</td>
<td>32</td>
<td>108.75</td>
<td>3.46</td>
<td></td>
<td>.885</td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

Table 4.2 discovered that at the p value (p=.000<0.05), noteworthy distinction was not initiated in the mean scores of conventional group’s pretest (M=108.88) and posttest (M=108.75). So, no notable change in the motivation test scores of conventional group during pretest and posttest was acknowledged. Then, it was established that learners were not instructed by problem solving approach getting similar responses in pretest and posttest towards motivation.
Ho1.4 There is no significant difference in the pre-test motivation mean score of the experimental and control group.

Table 4.3

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>32</td>
<td>108.97</td>
<td>5.57</td>
<td></td>
<td>.075</td>
<td>.941</td>
</tr>
<tr>
<td>Control</td>
<td>32</td>
<td>108.88</td>
<td>4.37</td>
<td>62</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

It is observed from above table 4.3 that at the value (p=.000<0.05), notable difference was not recognized in the mean scores of interventional group’s pretest (M=108.97) and conventional group’s pretest (M=108.88). Thus, no notable distinction in the pretest motivation mean score of the interventional and conventional group was established. It showed that learners of both groups were not educated with problem solving approach showing equal motivation towards mathematics.
Ho1.5 There is no significant differences in the post-test motivation mean score of the experimental and control group.

Table 4.4

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>32</td>
<td>137.94</td>
<td>2.49</td>
<td>62</td>
<td>38.78</td>
<td>.000</td>
</tr>
<tr>
<td>Control</td>
<td>32</td>
<td>108.75</td>
<td>3.455</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

It is manifested from above table 4.4 that at the p value (p=.000<0.05), a noteworthy difference in the mean scores of interventional group (M=137.94) and conventional group (M=108.75) was initiated. However, there is no notable change in posttest motivation test score of the interventional and conventional group was denied. It determined that learners were educated by problem solving approach gaining greater motivation level in post-test as compared whereas conventional group learners who instructed with customary technique.
Ho2.1 There is no significant effect of problem solving approach on students’ academic achievement in mathematics at elementary level.

Ho2.2 There is no significant difference in the pre-test posttest academic achievement means score of experimental group.

Table 4.5

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>32</td>
<td>24.81</td>
<td>4.572</td>
<td>31</td>
<td>-62.958</td>
<td>.000</td>
</tr>
<tr>
<td>Post-test</td>
<td>32</td>
<td>90.33</td>
<td>3.899</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

It is perceived from table 4.5 that at the p value (p=.000<0.05) notable difference was originated among the mean scores experimental group’s before intervention (M=24.81) and after intervention (M=90.33). Then, the difference is not notable in the pretest posttest academic achievement mean scores of interventional group, was disallowed. It showed that learners instructed by problem solving approach obtaining greater scores relative learners educated with customary technique.
There is no significant difference in the pre-test post-test academic achievement means score of control group.

Table 4.6

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>32</td>
<td>24.48</td>
<td>4.59</td>
<td></td>
<td>31</td>
<td>-1.587</td>
</tr>
<tr>
<td>Post-test</td>
<td>32</td>
<td>26.44</td>
<td>5.72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<0.05

It is obvious from table 4.6 that at the p value (p=.000<0.05), noteworthy distinction was not originated among the mean scores conventional group’s pretest (M=24.48) and posttest (M=26.44). Therefore, there is no notable distinction during the pretest posttest academic achievement test scores of conventional group, was acknowledged. It showed that learners were not instructed with problem solving approach acquiring identical scores in pre-test and post-test towards achievement.
There is no significant difference in the pre-test academic achievement mean score of the experimental and control group.

Table 4.7

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>32</td>
<td>24.81</td>
<td>4.57</td>
<td>62</td>
<td>.286</td>
<td>.775</td>
</tr>
<tr>
<td>Control</td>
<td>32</td>
<td>24.48</td>
<td>4.59</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

Above table 4.7 presented that at the value (p=.000<0.05), notable distinction was not originated in the mean scores of experimental group’s pre-test (M=24.81) and control group’s pre-test (M=24.48). Thus, no noteworthy distinction in the pretest motivation test score of the interventional and conventional group was recognized. It revealed that learners of both groups were not instructed by problem solving approach obtaining similar academic achievement in pre-test.
Ho2.5 There is no significant difference in the post-test academic achievement mean score of the experimental and control group.

Table 4.8

Comparison of experimental and control groups’ post-test score of academic achievement by Independent sample t-test

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>32</td>
<td>90.33</td>
<td>3.89</td>
<td>62</td>
<td>52.22</td>
<td>.000</td>
</tr>
<tr>
<td>Control</td>
<td>32</td>
<td>26.44</td>
<td>5.72</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

It is obvious from above table 4.8 at the p value (p=.000<0.05), a noteworthy distinction in the test scores of interventional group (M=90.33) and conventional group (M=26.44) was initiated. Consequently, no notable distinction in the posttest academic achievement mean score of the interventional and conventional group was declined. It presented such learners were instructed by problem solving approach gaining greater scores in post- test as compared to conventional group learners who imparted by traditional system. However, the learners of interventional group achieved higher marks than the conventional group after experiment.
Ho3.1 There is no noteworthy relationship between students’ motivation and academic achievement in mathematics at elementary level.

Ho3.2 There is no noteworthy relationship in pre-test of motivation and academic achievement of experimental group in mathematics.

Table 4.9

*Pearson Correlation of pre-test between motivation and academic achievement of experimental group*

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>r</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation (pre-test)</td>
<td>32</td>
<td>.163</td>
<td>.372</td>
</tr>
<tr>
<td>Academic achievement score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(pre-test)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.01 level (2 tailed)*

Table 4.9 showed that noteworthy relationship was not verified in motivation and academic achievement of learners (r=.163, p=.372). Hence, the null hypothesis Ho3.2, noteworthy relationship in pretest motivation and academic achievement of interventional group in mathematics prior mediation was established. It decided, it was a positive yet weak relationship in motivation and academic achievement of learners in pretest.
Ho3.3 There is no noteworthy relationship in post-test of motivation and academic achievement of experimental group in mathematics.

Table 4.10

*Pearson Correlation of post-test between motivation and academic achievement of experimental group*

<table>
<thead>
<tr>
<th>Variables</th>
<th>$N$</th>
<th>$r$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation (post-test)</td>
<td>32</td>
<td>.577</td>
<td>.001</td>
</tr>
<tr>
<td>Academic achievement score (post-test)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.01 level (2 tailed)*

Table 4.10 presented that notable relationship was originated in motivation and academic achievement of learners ($r=.577, p<.01$). So, the null hypothesis, no noteworthy relationship in post-test of motivation and academic achievement of experimental group in mathematics posterior intervention was rejected. It indicated, there was a positive moderate relationship in motivation and academic achievement of learners in posttest.
Ho3.4 There is no noteworthy relationship in pre-test of motivation and academic achievement of control group in mathematics

Table 4.11

*Pearson Correlation of pre-test between motivation and academic achievement of control group*

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>r</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation (pre-test)</td>
<td>32</td>
<td>0.118</td>
<td>0.520</td>
</tr>
<tr>
<td>Academic achievement score (pre-test)</td>
<td>32</td>
<td>0.118</td>
<td>0.520</td>
</tr>
</tbody>
</table>

*p<0.01 level (2 tailed)*

Table 4.11 exhibited that noteworthy relationship was not originated in motivation and academic achievement of learners (r=0.118, p=0.520). However, no notable relationship in pretest of motivation and academic achievement of conventional group in mathematics was acknowledged. Furthermore, it was a positive yet weak relationship in motivation and academic achievement of learners in pretest.
Ho3.5 There is no noteworthy relationship in post-test of motivation and academic achievement of control group in mathematics

Table 4.12  
*Pearson Correlation of post-test between motivation and academic achievement of control group*

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>r</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation (post-test)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic achievement score (post-test)</td>
<td>32</td>
<td>.071</td>
<td>.701</td>
</tr>
</tbody>
</table>

*p<0.01 level (2 tailed)*

Table 4.12 presented that notable relationship was not commenced in motivation and academic achievement of learners (*r*=.07, *p*=.70). However, no noteworthy relationship in posttest of motivation and academic achievement of conventional group in mathematics was anticipated. It determined that there was a positive yet very weak relationship in motivation and academic achievement of learners in posttest.
CHAPTER V

SUMMARY, FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Summary

The present National Curriculum (2006) discusses the development of problem solving approach and advancement of progressive aspects in the direction of learning of mathematics. In addition, the public educational plan for mathematics 2006 evidently demands a documents and invention built culture involves individuals, who may anticipate multifaceted subjects, examine and adjust to new circumstances, tackle problems of diverse sorts and provide their thinking successfully. The reason for this study was to define the effect of problem solving approach as contrasted with conventional technique in the subject of mathematics for class eight. However, the study was directed on eighth grade compulsory subject mathematics. The study was experimental in nature. Quasi- experimental design (pre-test post-test control group design) was applied in this study. The population of this study was contained of all elementary school pupils of eighth grade in Lahore. The sample of the study was comprised of the intact groups of learners of eighth class in a public girls’ institute of Lahore. These intact groups were randomly assigned to interventional and conventional group. Intact groups for pretest and posttest were employed for data gathering.

Problem Solving Approach (PSA) for the experiment was developed by the researcher using George Polya’s heuristic steps of the problem-solving approach, covering three units from the textbook of mathematics of eighth grade. Learners of the interventional group were instructed with problem solving approach. The conventional group was educated with the formal customary manner. The experiment
was conducted for a period of sixteen weeks. Two research instruments were used in this present experimental study. The questionnaire of Mathematics Motivation Scale was adapted to measure students’ motivation towards mathematics at start (pre-test) and end of experiment (post-test). Academic achievement test of mathematics was assessed by utilizing objective and subjective type test. In addition, the test of mathematics was scored through rubrics to quantity the outcomes of the learners on achievement test. Data was analyzed by using descriptive (mean score) and inferential statistics (t-test). Moreover, Pearson ‘r’ test was applied to identify the relationship in learners’ motivation and academic achievement in mathematics.

**Findings**

The null hypothesis Ho1.2, which identified no noteworthy distinction in the pretest posttest motivation test scores of interventional group, was rejected. So, it proved that learners who were educated with problem solving approach presenting more motivation as compared to the learners educated through conventional technique. Null hypothesis Ho1.3 claiming no noteworthy modification during the pretest posttest motivation test scores of conventional batch was established. This specified that learners were not instructed by problem solving approach showing similar motivation in pre-test and post-test.

A noteworthy distinction was not found in the pretest motivation test scores of interventional and conventional group. It showed that learners of both groups were not instructed by problem solving approach viewing equal motivation. Furthermore, a noteworthy change \( t = 38.78, p < 0.05 \) was found in the posttest motivation test scores of interventional and conventional arrays. It indicated that motivation mean score of interventional group’s learners instructed through problem solving approach was significantly higher than instructed through customary way.
Furthermore, a noteworthy modification was established among the pretest-posttest academic achievement mean score of interventional group. It revealed that learners trained by problem solving approach taking greater scores relatively learners instructed by customary manner. Findings also showed that learners were not imparted by problem solving approach acquiring identical scores in pre-test and post-test towards achievement.

It was observed that at the level (p=.000<0.05), noteworthy change was not initiated among the mean scores of experimental group’s and control group’s post-test. It established that learners of both groups were not educated with problem solving approach expressing equivalent academic achievement in pre-test. A significant difference (t = 52.22, p < 0.05) among the mean scores of interventional and conventional group was initiated. It evident that learners were instructed by problem solving approach acquiring better scores in post-test relative conventional group.

A noteworthy relationship was not recognized among motivation and academic achievement of learners (r=.163, p=.372). So, it revealed that this was a positive however slight relationship in motivation and academic achievement of learners in pre-test. A notable relationship was originated among motivation and academic achievement of pupils (r=.577, p=.001). Hence, it proved that this was a positive moderate relationship among motivation and scholastic achievement of learners in post-test. A noteworthy relationship was not originated in motivation and academic achievement of learners (r=.07, p=.70). However, it indicated that this was a positive yet very weak relationship among motivation and academic achievement of learners in post-test.
Discussion

The aim of teaching is to make learners for tackling problems confronted each day. The topics that can lead learners to solve every day questions in mathematics. Mathematics is a pillar of practically all the streams in academic sectors. Mathematics is an educational program content that has a capacity as a device of problem solving to assist individual explains subjects throughout everyday life (Hadiyanti & Mulyono, 2018). A mathematical tricky can be characterized by utilizing the meaning of a problem, as numerical matter is a difficult which involves numerical reasoning, challenge and a blend of recently learned numerical develops (Diaz et al., 2017).

This study found that learners who were instructed with problem solving approach having greater motivation than the students educated through conventional method. These finding supported to the notion of Hu et al. (2018), Problem based learning increased students’ interest in math intrinsic motivation and ability beliefs. The finding further supported to the idea of Gok and Silay (2010), when achievement of the learners improved in problem solving, then achievement and motivation of the learners enlarged. A noteworthy change was not initiated among test scores of pre-test of the interventional and conventional group on motivation. This was in support of Argaw et al. (2016) who expressed that learners of both groups were not instructed with problem solving approach devising similar motivation. These findings also supported that the study of Harun et al. (2012), who indicated that learners’ reactions towards motivation were increased using problem based learning. Moreover, pupils are educated to be self-directed intellectuals to solve actual life problems through problem solving method.

Problem solving approach is an operative instructing technique to develop students’ achievement and increase their interest in a subject towards education
(Usman & Sule, 2017). This study found that learners of both groups were not instructed through problem solving approach acquiring equal academic achievement in pre-test. This was in support of Lestari (2019) who expressed that interventional and conventional groups scored nearly the similar on the pre-test test. However, the present study found that pupils were trained using PSA getting greater marks in post-test as contrasted to conventional group learners who educated by previously outdated method. These findings were in support of problem solving approach have a positive impact on the students of the experimental group (Darma, 2018).

In addition, there was a noteworthy and positive effect on problem solving skill in mathematics subject. The finding also supported to the idea of Behlol (2018) who stated that numerical thinking capacities whose learning with problem solving approach is superior than the learners who get traditional learning. Also, Ali (2010) in his investigation on the impact of utilizing problem solving approach in instructing mathematics on the accomplishment of arithmetic learners established that there was noteworthy change in the viability of conventional training strategy and problem solving strategy in educating of mathematics at rudimentary level. Moreover, Parveen (2010) expressed in her study that learners imparted by problem solving method accomplished superior than those instructed by conventional method. Furthermore, Ayodhya (2007) revealed that Polya’s heuristic approach is more operative than the conservative instruction method in increasing problem solving abilities. Similarly, Hu et al., (2018) further supported that problem-oriented instruction method was more operative in refining mathematics achievement than traditional teaching methods.

The current study found that there was significant positive relationship between post-test motivation and academic achievement of experimental group for learning mathematics after experiment. These finding supported to the notion of
Beyazsacli (2016), problem solving skill scores of the learners have presented modifications at a significant level contrasted to the adaptable of the assessment preparative motivation. In addition, greater problem solving capabilities of learners favorably marks their assessment preparative motivation. Kilic and Moralar (2015) also stated that the problem oriented approach has progressive consequence in academic achievement and in proliferation of motivation. The study revealed that there was notable relationship in post-test of motivation and academic achievement of experimental group. These findings supported to Amrai et al. (2011) who stated that a progressive and noteworthy relationship between motivation and academic achievement in particular analysis.

Conclusions

It was concluded that problem solving approach as a teaching learning method improves motivation of students. The students of experimental group’s post-test who taught through problem solving approach was highly motivated than those students of experimental group’s pre-test who taught through same traditional method. While other findings concluded that there was insignificant change in mean scores of conventional group’s pre-test and posttest. So, it was concluded that learners were not instructed by problem solving approach getting similar outcomes prior and posterior test concerning motivation. Results discovered that noteworthy change was not established in the pretest motivation mean scores of interventional and conventional group. It determined that learners of both sets were not educated with problem solving approach devising equal motivation.

However, the major finding concluded that learners of interventional group who instructed by problem solving approach showing greater motivation relatively to conventional group learners who instructed by same customary way. It was also
originated that there was no noteworthy change in the pre-test post-test academic achievement mean scores of conventional group. So, it was determined that learners were not trained by problem solving approach obtaining equal marks in pre-test and post-test concerning achievement. In addition, it was concluded that the learners of both groups were not instructed through problem solving approach getting similar academic achievement in pre-test. Finding established that there was notable change in post-test academic achievement mean score of interventional and conventional group. Hence, it was concluded that teaching-learning through problem solving approach is more effectively by comparing conventional method, to develop academic achievement of learners in mathematics.

It was settled that there is no noteworthy relationship in pre-test motivation and academic achievement of interventional group. Results showed that there was noteworthy relationship in post-test of motivation and academic achievement of interventional group for learning mathematics. So, it settled that there was moderately positive notable connection in motivation and academic achievement of students in post-test. It concluded that there was no noteworthy positive but week relationship between pre-test of motivation and academic achievement of control group in mathematics. Moreover, there was not noteworthy relationship between post-test of motivation and academic achievement of conventional group for learning mathematics.
Recommendations

In the light of results and conclusions, the subsequent recommendations are prepared:

1. The result of this study ascertained that problem solving approach is more operative teaching technique as compared to traditional methods. Therefore, teachers may be used problem solving approach in their teaching to improve students’ academic achievement and motivation towards mathematics.

2. Teaches may be trained about problem solving approach for teaching mathematics in elementary classrooms through seminars, workshops and conferences.

3. There may be organized in-service training programs for elementary mathematics teachers about problem solving teaching method.

4. Those students who are learning mathematics in elementary classes, problem solving approach may be helpful to improve their academic achievement and to increase motivation level in mathematics for solving real life problems and to be a good problem solver.

5. This study may be recommended for the educational program organizers, to plan and actualize mathematics exemplary lessons in elementary institutes with the goal that educators may utilize the methods for instructing by problem solving.

6. The study may be recommended for the textbook writers to integrate problem solving approach in mathematics substances to current intellectual thoughts in more significant manner to fulfill the requirements of the National Curriculum at elementary level.
Suggestions for Future Study

1. This study investigated the effect of problem solving approach on learners’ motivation and academic achievement in mathematics. The researches may be designed to examine the use of problem solving method on another dependent variables like attitude, self-esteem, critical thinking in future.

2. The current study was directed at the elementary level. Upcoming studies may be investigated at secondary, college or universities level in Pakistan.

3. The present study was designed for the subject of mathematics. The future studies may be directed to discover the impact of problem solving on learners’ achievement in science subject.
REFERENCES


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APPENDICES

APPENDIX A

Consent Letter

Respected Headmistress,

A research is being launched based on to explore the Effect of Problem Solving Approach on Students’ Motivation and their Academic Achievement in Mathematics in your school. This will continue for 16 weeks, there is no physical and psychological harm and any risk to the students. The information collected during this study will be kept confidential and only be used for research purpose.

No remuneration will be paid to the students for participating in the research. If you are willing to let your students to participate in the research, you are requested to fill the consent letter.

Researcher,

Institute of Education and Research,

University of the Punjab, Lahore

I have read the details of research study. I allow the services of my school students to participate in this research.

Signature: _________________________
Name: ____________________________
Date: ____________________________
APPENDIX-B

Panel of Mathematics Teachers for Validation of Academic Achievement Test of Mathematics

1. Miss Afsheen Ashraf (Mathematics Teacher)

2. Miss Munnaza Rasheed (Mathematics Teacher)
   Govt. Elementary School Charrar Lahore Cantt

3. Miss Rabia Zulfiqar (Mathematics Teacher)
   Govt. Elementary School Sikandria Colony, Bank Road Lahore

4. Dr. Tahira Batool (Assistant Professor)
   Lahore College for Women University, Lahore.
APPENDIX-C

Panel of Mathematics Teachers for Preparation of Lesson Planes

1. Miss Gulnaz Lutfullah (Mathematics Teacher)

2. Mrs. Naila Sajid (Lecture of Mathematics)
   Lahore College for Women University, Lahore.

3. Dr. Sara Shafiq (Lecturer of Mathematics)
   Lahore College for Women University, Lahore.

4. Dr. Asim Nazir (Lecturer of Mathematics)
   Institute of Education & Research, University of the Punjab, Lahore.
APPENDIX-D

Panel of Urdu Teachers for Translation in Urdu of Mathematics

Motivation Scale

1. Mrs. Farhat Adeeba (Urdu Teacher)
   Govt. Girls Elementary School, Nawabpura Lahore

2. Miss Sayeda Ayesha (Urdu Teacher)
   City District Girls High School, Herbanspura Lahore

3. Muneeba Malhooz (Urdu Teacher)
   Govt. Girls High School Madrasa-tul-binat Misri Shah, Lahore

3. Miss Anjum Darkhasha (Urdu Teacher)
   City District Govt. Girls High School Wahdat Colony Lahore
## Mathematics Motivation Scale

**Name:** __________  
**Section:** _________

Please read the statements carefully and tick (√) the relevant answer which best suits to your level of agreement against each statement by using the following key words:

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Statements</th>
<th>Strongly Disagree (SDA)</th>
<th>Disagree (DA)</th>
<th>Normal (N)</th>
<th>Agree (A)</th>
<th>Strongly Agree (SA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In math class, I would like to have some challenging materials and they will make me learn more.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>My biggest wish is to understand the content of the learning material used in the math class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>In math class, I would like to have more projects and homework which will help me learn more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Learning math can improve my thinking logics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>To get better score in math, I will learn harder.</td>
<td>بیاگی مش مختصرحاصل کرئے کے لئے لیمو مزید محبت کردی کرئے</td>
<td>Extrinsic Goal Orientation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>My most wanting is to get best grades in math class.</td>
<td>گی ریاضی میں بہتر نمبر حاصل کرنے کے لیے میں مزید محبت کرئے</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Mathematics can improve my overall academic score.</td>
<td>ریاضی نے جوگی اتقان نمرات بہتر کر میں</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I hope I can get higher grade in math than any other classmates.</td>
<td>مجھے امید ہے کہ میں ریاضی میں دوسرے میں مزید میں ابتو نمبر لے جا سکوں گی</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I want to get higher scores in math class, because I want to demonstrate my capability to my classmates.</td>
<td>میں نکہ میں ریاضی کے مضمون میں اپنی توانائی کے بارے میں اپنے اپنے</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>My best wish is to attend ideal school through learning math.</td>
<td>میرے اسپسے بزی دیا تو انہی کے بارے میں کر بہترین ہوئے</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>I want to get other people’s recognition so I want higher scores in math class.</td>
<td>میں نکہ جنگر نمبر حاصل کرے کے لوگوں کے درمیان اپنی توانائی کرہتا ہوئے</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>The skills I learn from the math class can be applied in other classes.</td>
<td>میں ریاضی کی مضمون میں کچھ جاں والی میں دوسری جماعت میں مزید توانائی بھیکے</td>
<td>Task Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>I am interested in the learning material in math class.</td>
<td>میں ریاضی کی مضمون میں کچھ جاں والی میں دوسری جماعت میں مزید توانائی بھیکے</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>I feel the learning materials used in math class are useful.</td>
<td>میں ریاضی کی مضمون میں کچھ جاں والی میں دوسری جماعت میں مزید توانائی بھیکے</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>I like every topics and contents in math class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>What I learn in the math class can be apply in my daily life.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Mathematics contributes a lot to whole human beings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Control Beliefs for Learning

<p>| 18 | If I have correct learning pattern to learn math, I will learn better in the class. |
| 19 | If I do not learn better in the math class, I believe it is my fault. |
| 20 | If I study hard enough, I can understand the content of the learning materials used in math class. |
| 21 | If I could not understand every topics in math class, that is because I did not work hard enough. |
| 22 | If I pay full attention in math class, I can get better grades. |
| 23 | If I have enough time to do practice in math, I will have better performance. |</p>
<table>
<thead>
<tr>
<th><strong>Self-efficacy</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>24</strong></td>
<td>I believe that I will have excellent math grades in math class.</td>
</tr>
<tr>
<td></td>
<td>مجھے یقین ہے کہ میں ریاضی میں بہت اچھے نمبر لوں گی۔</td>
</tr>
<tr>
<td><strong>25</strong></td>
<td>I believe that I can understand the most difficult part in the math materials by my own.</td>
</tr>
<tr>
<td></td>
<td>مجھے یقین ہے کہ میں ریاضی کا سب سے مشکل مواد کو خودمختار کر سکتا ہوں۔</td>
</tr>
<tr>
<td><strong>26</strong></td>
<td>I believe that I can master every topic in math class.</td>
</tr>
<tr>
<td></td>
<td>مجھے یقین ہے کہ میں ریاضی کے ہر موضوع میں مہارت حاصل کر سکتا ہوں۔</td>
</tr>
<tr>
<td><strong>27</strong></td>
<td>As for math, I am competent to teach other my classmates.</td>
</tr>
<tr>
<td></td>
<td>ریاضی کے لحاظ سے، میں اپنے ہم جماعت کو پڑھا نے کی توانائی کے لئے کپڑے بھیکتا ہوں۔</td>
</tr>
<tr>
<td><strong>28</strong></td>
<td>Math is not difficult to me.</td>
</tr>
<tr>
<td></td>
<td>ریاضی نہیں مشکل لیے۔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Test Anxiety</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>29</strong></td>
<td>In taking math exam, I will have negative thought that I am inferior than other classmates.</td>
</tr>
<tr>
<td></td>
<td>ریاضی کے امتحان میں، میں نینہ کیسے تمہارے ساتھیوں سے کم خوبصورت کرئیں ہوں۔</td>
</tr>
<tr>
<td><strong>30</strong></td>
<td>In taking math exam, I will keep thinking of the questions that I cannot answer in previous part.</td>
</tr>
<tr>
<td></td>
<td>ریاضی کے امتحان میں، میں باقی بخش میں سوالات سے کم نیکا ہوں۔</td>
</tr>
<tr>
<td><strong>31</strong></td>
<td>In taking math exam, I would think about the consequence of failing in the exam.</td>
</tr>
<tr>
<td></td>
<td>ریاضی کے امتحان میں، میں سوالات سے کم نیکا ہوئے کے پچھلے میں میں کچھ میں سوچتے رہوں گے۔</td>
</tr>
<tr>
<td><strong>32</strong></td>
<td>In taking exam, I feel nervous and worry.</td>
</tr>
<tr>
<td></td>
<td>ریاضی کے امتحان میں، میں گھبراہٹ اور پریشانی محسوس کرئیں ہوں۔</td>
</tr>
<tr>
<td><strong>33</strong></td>
<td>In taking math exam, my heart beat faster.</td>
</tr>
<tr>
<td></td>
<td>ریاضی کے امتحان میں، میں دل کی دھڑکن بڑھ جاتی ہو۔</td>
</tr>
<tr>
<td><strong>34</strong></td>
<td>In taking math exam, I am totally blank and cannot remember what I have learned before.</td>
</tr>
<tr>
<td></td>
<td>ریاضی کے امتحان میں، میں کمل خالی ایک بار میں سوالات سے کم نیکا ہوئے کہ کچھ میں سوچتے رہوں گے۔</td>
</tr>
</tbody>
</table>
# APPENDIX-F

Mathematics Achievement Test: Part- A

(Multiple Choice Questions)

Total Marks: 48  
Total Time: 1 hour

15 minutes

Name ___________________  
Section ____________

Instructions: Read carefully and attempt all questions. Encircle the correct option of each of Multiple Choice Questions (MCQs). Each question carries 1.5 marks. If more than one option is encircled in a question, no mark will be given.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Rough Work</th>
</tr>
</thead>
</table>
| 1. \(9a - 3b + 81c =\)  
a) \(3(3a - b - 27c)\)  
b) \(3(3a - b + 27c)\)  
c) \(9(a - 3b - 3c)\)  
d) \(9(a - 3b + 9c)\) |
| 2. If \(X + \frac{1}{X} = -4\), then the value of \(\frac{X^2}{\frac{1}{X}}\) is:  
a) \(-16\)  
b) \(-14\)  
c) \(14\)  
d) \(16\) |
| 3. Factorization of \(16X^2 - 24X + 9 - Y^2\) is:  
a) \((4x + y - 3)(4x - y - 3)\)  
(4x - y +3)  
c) \((4x + y -3)(4x+ y -3)\)  
(4x + y +3)  
d) \((4x + y +3)\) |
| 4. \(a^2 - 1 =\)  
a) \((a - 1)(a - 1)\)  
b) \((a - 1)(a + 1)\)  
c) \((a + 1)(a + 1)\)  
d) \((1 - a)(1 + a)\) |
5. \(X^2 - 729 =
\begin{align*}
a) & \quad (x - 9) (x^2 + 9x + 81) \\
b) & \quad (x + 9) (x^2 + 9x + 81) \\
c) & \quad (x - 9) (x^2 - 9x + 81) \\
d) & \quad (x + 9) (x^2 - 9x - 81)
\end{align*}

6. \((3X - 2Y)^2 =
\begin{align*}
a) & \quad 9x^2 + 4xy - 12y^2 \\
b) & \quad 9x^2 + 4xy + 4y^2 \\
c) & \quad 9x^2 - 12xy - 4y^2 \\
d) & \quad 9x^2 - 12xy + 4y^2
\end{align*}

7. After eliminating “Y” from the equations \(X + Y = 4\) and \(Y = -3\), we get:
\[X = \frac{7}{2}\]
\begin{align*}
a) & \quad X = 1 \\
b) & \quad X = 3 \\
c) & \quad X = 4 \\
d) & \quad X = 7
\end{align*}

8. If \(x - \frac{1}{x} = -6\), then the value of \(x^2 + \frac{1}{x^2}\) is:
\[\frac{25}{2}\]
\begin{align*}
a) & \quad 12 \\
b) & \quad 34 \\
c) & \quad 36 \\
d) & \quad 38
\end{align*}

9. \((4a + b)^3 =
\begin{align*}
a) & \quad 64a^3 + 48a^2b + 12ab^2 + b^3 \\
b) & \quad 64a^3 - 48a^2b + 12ab^2 + b^3 \\
c) & \quad 64a^3 + 48a^2b - 12ab^2 + b^3 \\
d) & \quad 64a^3 - 48a^2b - 12ab^2 + b^3
\end{align*}

10. \(4y^2 - 12y + 9 =
\begin{align*}
a) & \quad (4y - 9)^2 \\
b) & \quad (4y + 9)^2 \\
c) & \quad (2y + 3)^2 \\
d) & \quad (2y - 3)^2
\end{align*}

11. In the given figure, \(<A\) and \(<B\) are _________ angles:
\[\text{a)} \text{Supplementary} \\
\text{b)} \text{Corresponding}
\]
c) Alternate interior  

d) Vertically opposite

12. Each interior angle of a regular hexagon is of measure:

\[120^\circ\]

a) 60^\circ  
b) 80^\circ  
c) 100^\circ  
d) 120^\circ

13. The measure of each interior angle of a regular polygon is 120^\circ, the number of sides of this regular polygon is:

\[\frac{180(n-2)}{n} = 120^\circ\]

a) 5  
b) 6  
c) 7  
d) 8

14. In the given figure the value of “a” is:

\[a = 115^\circ - 40^\circ = 75^\circ\]

a) 35^\circ  
b) 40^\circ  
c) 65^\circ  
d) 115^\circ

15. In the given figure, the value of “x” is:

\[70^\circ = (5x+10)^\circ\]

a) 12  
b) 60  
c) 65  
d) 80
16. Number of sides of a polygon is:

- a) One or more
- b) Two or more
- c) Three or more
- d) Four or more

17. The given figure is called:

- a) pentagon
- b) hexagon
- c) heptagon
- d) octagon

18. Vertically opposite angles are _________.

- a) Congruent
- b) Supplementary
- c) Complementary
- d) Unequal

19. The shaded region of the given figure is called:

- a) Chord
- b) Secant
- c) Tangent
- d) Sector

20. In the given figure, a pair of alternate interior angles is:

- a) <1, <2
- b) <1, <3
- c) <2, <4
- d) <2, <3
21. The value of "X" in the given right angled triangle is:

\[ \triangle ABC \]

- a) 8cm
- b) 12cm
- c) 18cm
- d) 65cm

22. If a cone has slant height 6cm and radius of base 4cm, then its total surface area will be:

- a) 10 \( \pi \) m\(^3\)
- b) 16 \( \pi \) m\(^3\)
- c) 24 \( \pi \) m\(^3\)
- d) 40 \( \pi \) m\(^3\)

23. The slant height of a cone is 10cm and radius of its base is 7cm, its curved surface area will be:

- a) 44 cm\(^2\)
- b) 220 cm\(^2\)
- c) 374 cm\(^2\)
- d) 440 cm\(^2\)

24. The surface area of a sphere with radius 4cm is:

- a) 16 \( \pi \) cm\(^2\)
- b) 32 \( \pi \) cm\(^2\)
- c) 48 \( \pi \) cm\(^2\)
- d) 64 \( \pi \) cm\(^2\)

25. The radius of a spherical tank is 9 meters, its volume is:

- a) 108\( \pi \) m\(^3\)
- b) 729\( \pi \) m\(^3\)
- c) 927\( \pi \) m\(^3\)
- d) 972\( \pi \) m\(^3\)

26. The surface area of a sphere is 5544cm\(^2\), its radius is:

- a) 21cm
- b) 22 cm
- c) 42 cm
- d) 98 cm

27. The area of a right angled triangle whose base is 3cm and height is 6cm = ________.

- a) 9cm\(^2\)
- b) 16cm\(^2\)
- c) 25cm\(^2\)
- d) 64cm\(^2\)
28. The number of times a value occurs in a data is called the _______ of that value.

- a) Mean
- b) Median
- c) Mode
- d) Frequency

29. The median of the data 32, 31, 36, 35, 37 is:

- a) 31
- b) 32
- c) 35
- d) 36

30. In the data 1, 3, 7, 7, 7, 11 the frequency of 7 is:

- a) 1
- b) 3
- c) 7
- d) 11

31. The statistical measure that identifies a single value as representative of an entire distribution is called:

- a) frequency distribution
- b) Median
- c) Mode
- d) Mean

32. In the frequency table given below, the class with minimum frequency is:

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>11-25</th>
<th>26-40</th>
<th>41-55</th>
<th>56-70</th>
<th>71-85</th>
<th>86-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>12</td>
<td>5</td>
<td>13</td>
<td>10</td>
<td>8</td>
<td>15</td>
</tr>
</tbody>
</table>

- a) 26 - 40
- b) 56 - 70
- c) 71 - 85
- d) 86 - 100
# Mathematics Achievement Test: Part-B

## Subjective Type

**Part-A:** 48 Marks, Part-B: 52 Marks, Total: 100 Marks

Total Time: 1 hour 30 minutes

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>_______________</td>
<td>________</td>
</tr>
</tbody>
</table>

Total Marks: 52

### Part-B (Open Ended Questions)

<table>
<thead>
<tr>
<th>Question</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. No. 33 (a) Eliminate X from ( \frac{1}{X} ) and ( \frac{1}{X^4} = m^4 )</td>
<td>5</td>
</tr>
<tr>
<td>(-X + \frac{1}{X^4} = m^4) &amp; (+X + \frac{1}{X} = 1)</td>
<td></td>
</tr>
<tr>
<td>(b) Find two solutions for the equation ( X + 5Y = 6 )</td>
<td>4</td>
</tr>
<tr>
<td>(X + 5Y = 6)</td>
<td></td>
</tr>
</tbody>
</table>

Q. No. 34. (a) If we subtract 2 from the half of a number, we get the same result as we add 3 to the quarter of that number. Find the number.

\(\)
(b) If \( \frac{1}{X} - \frac{1}{X^3} = 4 \), then find the value of \( X^3 - \frac{1}{X^3} \).

Q35. (a) The measure of one angle of a parallelogram is 85°. What are the measures of the other angles?

(b) The height of conical tent is 6 meter and radius of its base is 8 meter. Find the area of the canvas used to make this tent.

Q36 (a) By using Hero’s formula, find the area of a triangular region when the lengths of its sides are 6m, 5m and 5m.
(b) In an isosceles right angled triangle, the square of the hypotenuse is 100 cm$^2$. Find the length of each congruent side.

In an isosceles right angled triangle, the square of the hypotenuse is 100 cm$^2$. Find the length of each congruent side.

Q37. (a) Find the mean of the following frequency table.

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 5</td>
<td>4</td>
</tr>
<tr>
<td>6 - 10</td>
<td>1</td>
</tr>
<tr>
<td>11 - 15</td>
<td>5</td>
</tr>
<tr>
<td>16 - 20</td>
<td>4</td>
</tr>
<tr>
<td>21 - 25</td>
<td>2</td>
</tr>
<tr>
<td>26 - 30</td>
<td>1</td>
</tr>
</tbody>
</table>

(b) The number of units of electricity consumed by 22 houses are given below. Construct a frequency distribution table by taking size of class interval 10.

The number of units of electricity consumed by 22 houses are given below. Construct a frequency distribution table by taking size of class interval 10.

70, 31, 55, 61, 62, 31, 69, 72, 44, 50, 47, 25, 24, 25, 43, 64, 33, 55, 36, 45, 57, 73
# Key of the Objective Type Test

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>A</td>
</tr>
<tr>
<td>4</td>
<td>B</td>
</tr>
<tr>
<td>5</td>
<td>A</td>
</tr>
<tr>
<td>6</td>
<td>D</td>
</tr>
<tr>
<td>7</td>
<td>D</td>
</tr>
<tr>
<td>8</td>
<td>D</td>
</tr>
<tr>
<td>9</td>
<td>A</td>
</tr>
<tr>
<td>10</td>
<td>D</td>
</tr>
<tr>
<td>11</td>
<td>B</td>
</tr>
<tr>
<td>12</td>
<td>D</td>
</tr>
<tr>
<td>13</td>
<td>B</td>
</tr>
<tr>
<td>14</td>
<td>A</td>
</tr>
<tr>
<td>15</td>
<td>C</td>
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<tr>
<td>16</td>
<td>B</td>
</tr>
<tr>
<td>17</td>
<td>A</td>
</tr>
<tr>
<td>18</td>
<td>A</td>
</tr>
<tr>
<td>19</td>
<td>D</td>
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<tr>
<td>20</td>
<td>D</td>
</tr>
<tr>
<td>21</td>
<td>B</td>
</tr>
<tr>
<td>22</td>
<td>D</td>
</tr>
<tr>
<td>23</td>
<td>B</td>
</tr>
<tr>
<td>24</td>
<td>D</td>
</tr>
<tr>
<td>25</td>
<td>D</td>
</tr>
<tr>
<td>26</td>
<td>A</td>
</tr>
<tr>
<td>27</td>
<td>A</td>
</tr>
<tr>
<td>28</td>
<td>C</td>
</tr>
<tr>
<td>29</td>
<td>C</td>
</tr>
<tr>
<td>30</td>
<td>B</td>
</tr>
<tr>
<td>31</td>
<td>A</td>
</tr>
<tr>
<td>32</td>
<td>A</td>
</tr>
</tbody>
</table>
APPENDIX - I

Rubrics for Subjective Type Test

Q.No.33. (a) Eliminate $X$ from $X + \frac{1}{X} = l$ and $X^4 + \frac{1}{X^4} = m^4$

(5)

$\frac{(X+\frac{1}{X})^2}{\frac{1}{X^2}} = l^2$

$X^2 + \frac{1}{X^2} + 2 = l^2$

$X^2 + \frac{1}{X^2} = l^2 - 2$

$\left(\frac{X^2 + \frac{1}{X^2}}{X^2}\right)^2 = (l^2 - 2)^2$

$X^4 + \frac{1}{X^4} + 2 = l^4 - 4l^2 + 4$

$X^4 + \frac{1}{X^4} = l^4 - 4l^2 + 4 - 2$

$m^4 = l^4 - 4l^2 + 2$

$m^4 - l^4 = - 4l^2 + 2$

(5)

(b) Find two solutions for the equation $X + 5Y = 6$

(4)

If $Y = 0$ then

$X + 5 (0) = 6$

$X = 6$

If $Y = 1$ then

$X + 5 (1) = 6$
\( X = 6 - 5 \)  
\( X = 1 \)

The two solutions of the given equation are \((6, 0), (1, 1)\)

Q34(a) If we subtract 2 from the half of a number, we get the same result as we add 3 to \((5)\) the quarter of that number. Find the number.

Suppose that required number = \( X \)

By given condition

\( \frac{X}{2} - 2 = \frac{X}{4} + 3 \)  
\( \frac{X}{2} - \frac{X}{4} = 3 + 2 \)  
\( \frac{2X - X}{4} = 5 \)  
\( \frac{X}{4} = 5 \)  
\( X = 5 \times 4 \)

Required number = \( X = 20 \)

Q34. (b) If \( X - \frac{1}{X} = 4 \), then find the value of \( X^3 - \frac{1}{X^3} \)
X^3 - 3 \left( X - \frac{1}{X} \right) - \frac{1}{X^3} = 64 \\
0.5 \text{ mark}

X^3 - 3 \left( 4 \right) \frac{1}{X^3} = 64 \\
1 \text{ mark}

X^3 - 12 - \frac{1}{X^3} = 64 \\
0.5 \text{ mark}

X^3 - \frac{1}{X^3} = 64 + 12 \\
0.5 \text{ mark}

X^3 - \frac{1}{X^3} = 76 \\
0.5 \text{ mark}

Q35. (a) The measure of one angle of a parallelogram is 85°. What are the measures of the other angles?

(5)

Let

One angle of parallelogram = X \\
0.5 \text{ mark}

X + 85° = 180° \\
2 \text{ marks}

X = 180° - 85° \\
1 \text{ mark}

X = 95° \\
1 \text{ mark}

Thus the required angle is 85° and 95°. \\
0.5 \text{ mark}

(b) The height of conical tent is 6 meter and radius of its base is 8 meter. Find the area of the canvas used to make this tent.

(5)

Height = h = 6 m

Radius = r = 8 m

Length = l = \sqrt{r^2 + h^2} = \sqrt{(8)^2 + (6)^2} = \sqrt{64 + 36} = \sqrt{100} = 10 \text{ m} \\
2 \text{ Marks}
Curved surface area = \( \pi rl \)  
\[
= \frac{22}{7} \times 8 \times 10 
\]
\[
= 251.43 \text{ m}^2 
\]

Q 36 (a) By using Hero’s formula, find the area of a triangular region when the lengths of its sides are 6m, 5m and 5m

By Hero’s rule, the area of a triangle with sides of lengths \( a \), \( b \), and \( c \) is given by

\[
\text{Area} = \sqrt{s(s-a)(s-b)(s-c)} 
\]

Given

\[ a = 6 \text{ m} \]

\[ b = 5 \text{ m} \]

\[ c = 5 \text{ m} \]

\[
s = \frac{a+b+c}{2} = \frac{6+5+5}{2} = \frac{16}{2} = 8 \text{ m} 
\]

\[
\text{Area} = \sqrt{s(s-a)(s-b)(s-c)} = \sqrt{8(8-6)(8-5)(8-5)} 
\]

\[
= \sqrt{144} 
\]

\[ = 12 \text{ m} \]

(b) In an isosceles right angled triangle, the square of the hypotenuse is 100 cm².

Find the length of each congruent side.

In an isosceles right angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

\[
(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Altitude})^2 
\]

\[
(100\text{ cm})^2 = (X)^2 + (X)^2 
\]

1 mark

0.5 mark
100cm² = X² + X²  

100cm² = 2X²  

X² = \frac{100}{2}  

X² = 50 cm²  

Taking Square root on both sides:  
\sqrt{X²} = \sqrt{50cm²}  

X = \sqrt{2 \times 5 \times 5}  

X = 5 \sqrt{2}  

Q37. (a) Find the mean of the following frequency table. (6)

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>1 - 5</th>
<th>6 - 10</th>
<th>11 - 15</th>
<th>16 - 20</th>
<th>21 - 25</th>
<th>26 - 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Class Interval</td>
<td>Frequency ($f$)</td>
<td>$x$</td>
<td>$f \times x$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>-----</td>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – 5</td>
<td>4</td>
<td>3</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 – 10</td>
<td>1</td>
<td>8</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 – 15</td>
<td>5</td>
<td>13</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 – 20</td>
<td>4</td>
<td>18</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 – 25</td>
<td>2</td>
<td>23</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 - 30</td>
<td>1</td>
<td>28</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \sum f = 17 \quad \sum fx = 231 \]

\[
\bar{x} = \frac{\sum fx}{\sum f} = \frac{231}{17} = 13.59
\]

2 marks

1 mark
(b) The number of units of electricity consumed by 22 houses are given below.

Construct a frequency distribution table by taking size of class interval 10.

کئے کئے گھروں کے بجلی کے استعمال کی تعداد حسب ذیل ہے- 10 کلومیٹر کے کلاس وقفہ کو چھوڑ دیں۔

70,31,55,61,62,31,69,72,44,50,47,25,24,25,43,64,33,55,36,45,57,73

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>Tally mark</th>
<th>Frequency (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 – 33</td>
<td>ⅠⅠⅠⅠ</td>
<td>6</td>
</tr>
<tr>
<td>34 – 43</td>
<td>ⅠⅠ</td>
<td>2</td>
</tr>
<tr>
<td>44 – 53</td>
<td>ⅠⅠⅠⅠⅠ</td>
<td>4</td>
</tr>
<tr>
<td>54 – 63</td>
<td>ⅠⅠⅠⅠⅠ</td>
<td>5</td>
</tr>
<tr>
<td>64 - 73</td>
<td>ⅠⅠⅠⅠⅠ</td>
<td>5</td>
</tr>
</tbody>
</table>

\[ \sum f = 22 \]

(Column- wise Marks:

Class Interval = 2 Marks, Tally mark = 2 Marks, Frequency = 2 Mark)
APPENDIX -J

MODEL OF LESSON PLAN

**Duration:** 45 minutes/2\textsuperscript{nd} period

**Subject:** Mathematics

**Class:** 8\textsuperscript{th}

**Topic:** Solution of Simultaneous Linear Equations in two variables

**Material required:** Routine classroom equipment, White Board, Marker, and Duster

**Teaching Method:** Polya’s Problem Solving Method

**Students’ learning outcomes (SLOs’):**

- To enable the students to solve the simultaneous linear equations in two variables.
- Give the concept of formation of linear equations in two variables.

**Previous Knowledge:**

Students are familiar with variables, constants, coefficients, and algebraic expressions.

**Introduction:**

Teacher will ask the students:

Q1. What is equation?

Q2. What is linear equation give example?

Q3. How can you find the value of variable in liner equation?

Q4. Do you know about simultaneous linear equations?

**Presentation:**

**Step-1:** Understand the problem

Read the problem carefully and find what is given and what to find?

**Step-2:** Devising a Plan How the unknown can be find e.g. by adding or by subtracting.
Step-3: Carry out the Plan.

Let’s do it and find a common method for solving the problems.

Step-4: Looking back

In problem solving, it is best to check the answer. Can we do a similar question?

Change the data and do it. When the answer checks out, make sure that you write your final answer with the correct labeling.

Simultaneous Linear Equations

- If two or more linear equations consisting of same set of variables are satisfied simultaneously by the same values of the variables, then these equations are called simultaneous linear equations.
- A linear equation in two variables is of the form $ax + by = c$, where $a$, $b$ and $c$ are constants.
- Two linear equations considered together, form a system of linear equations.

For example

\[ x + y = 2 \text{ and } x - y = 1 \]

is a system of two linear equations with two variables $x$ and $y$.

Example:

A number is half of another number. The sum of 3 times of first number and 4 times of second number is 22. Find the numbers.

Step 1: Understand the Problem

Make sure that you read the question carefully several times. Since we are looking for a number, we will let

$X = \text{first number}$

$Y = \text{second number}$
Step 2 Devise a plan (translate)

A number is half of another number. The sum of 3 times of first number and 4 times of second number is 22. Then, equation becomes:

\[ X = \frac{Y}{2} \]

\[ 3X + 4Y = 22 \]

Step 3 Carry out the plan (solve)

This step is about solution how we will solve simultaneous linear equations. Here we will use method of elimination of substitution to find out the value of first number “x” and the value of second number “y”.

\[ X = \frac{Y}{2} \] \hspace{1cm} \text{(i)}

\[ 3X + 4Y = 22 \] \hspace{1cm} \text{(ii)}

Find the value of “y” from equation (i) we get,

\[ X = \frac{Y}{2} \] \hspace{1cm} \text{(Multiplying by “2” on both sides)}

\[ Y = 2X \] \hspace{1cm} \text{(iii)}

Substitute the value of “Y” in equation (ii)

\[ 3X + 4(2X) = 22 \]
\[ 3X + 8X = 22 \]
\[ 11X = 22 \]
\[ X = \frac{22}{11} = 2 \]

Put the value of “X” in equation (iii)

\[ Y = 2X \]
\[ Y = 2(2) = 4 \]
Step 4 Look back (checking)

In this step after finding the values of first and second number, now we will check whether the results are accurate or not.

\[
X = \frac{Y}{2} \quad 3X + 4Y = 22
\]

\[
2 = \frac{4}{2} \quad 3(2) + 4(4) = 22
\]

\[
2 = 2 \quad 6 + 16 = 22
\]

\[
22 = 22
\]

Hence, it has checked \(X=2\) and \(Y = 4\) is the required solution.

Assessment

Formative assessment will be done during teaching. Teacher will write a problem on the white board while the students solve the simultaneous linear equations independently in class work; teacher supervises the students and helps them when required.

Home Work

Teacher will give the students to solve the exercise problems on page #115 from textbook at the end of the topic.

Reference

LES SON PLAN

Duration: 45 minutes/2\textsuperscript{nd} period

Subject: Mathematics

Class: 8\textsuperscript{th}

Topic: Factorization

Material required: Routine classroom equipment, White Board, Marker, and Duster

Teaching Method: Polya’s Problem Solving Method

Students’ learning outcomes (SLOs’):

After completion of this unit, the students will be able to:

- Explain Factors
- Factorize expression of the following types:
  - \(Ka + kb + kc\)
  - \(ac + ad + bc + bd\)
  - \(a^2 - b^2\)
  - \(a^2 + 2ab + b^2 - c^2\)
- Find Common Factors
- Solve the problems of factorization

Previous Knowledge:

Students are familiar with variables, constants, coefficients, exponent power

Introduction:

Teacher will ask the students:

Q1. What is a variable give example?

Q2. Do you know about factorization?
Factorization

Factors of an expression are the expressions whose product is the given expression. The process of expressing the given expression as a product of its factors is called ‘Factorization’ or ‘Factorizing’.

1. Type Ka + Kb + Kc:

Example 1: Factorize 2x – 4y + 6z

Step 1. Understand the Problem

Make sure that you read the question carefully. Since we are looking for a problem of factorize. Here, we know that in this problem, the variable x has coefficient ‘2’, variable y has coefficient ‘4’ and variable z has coefficient ‘6’.

Step 2. Devise a plan (translate)

In this problem factorize 2x – 4y + 6z, how are we going to solve problem? What will be the factor?

\[ = 2x - 4y + 6z \]
\[ = (1x + 1x) - (2x2)y + (2x3)z \]

Step 3. Carry out the plan (Solution)

Let’s do it and find factor common in each term for solving the problem.

\[ = 2x - 4y + 6z \]
\[ = (1x + 1x) - (2x2)y + (2x3)z \]
\[ = 2x - (2x2)y + (2x3)z \]
\[ = 2(x - 2y + 3z) \]

“2” is a factor common to each term

Step 4. Look Back (Checking)

To check this problem when we will multiply 2 into x, 2 into 2y and 2 into 3z then 2x –4y +3z will be come. It means that answer is correct.
Example 2

\[ x^2 - xy + xz \]

**Step 1. Understand the Problem**

Make sure that you read the question carefully. Since we are looking for a problem of factorize. Here, we know that “\(x^2\)” has power ‘2’ and its coefficient is ‘1’, xy and xz show the product of two variables.

**Step 2. Devise a plan (translate)**

In the problem of factorize \(x^2 - xy + xz\), what will be the factor common x, y or z?

\[ = x^2 - xy + xz \]
\[ = (x \times x) - xy + xz \]

**Step 3. Carry out the plan (Solution)**

Let’s do it and find factor common in each term for solving the problem.

\[ = x^2 - xy + xz \]
\[ = (x \times x) - xy + xz \]
\[ = x (x - y + z) \]

“x” is a factor common to each term

**Step 4. Look Back (Checking)**

To check this problem when we will take product x into x, x into y and x into z then \(x^2 - xy + xz\) will come. Hence, answer is correct.

**Assessment**

Formative assessment will be done during teaching. Teacher will write a problem on the white board while the students solve the simultaneous linear equations independently in class work; teacher supervises the students and helps them when required.

**Home Work**

Teacher will give the students to solve the exercise problems on page #101 from textbook at the end of the topic.
Fwd: Fw: Request for Permission of using instrument

Bushra Phd <bushraphd18@gmail.com>
To: sijjaesarwar.ier@gmail.com

Wed, Feb 12, 2020 at 6:16 AM

----- Forwarded message -----
From: Eric Liu <lotem.ncu@gmail.com>
Date: Tue, 9 Jul 2019, 18:33
Subject: Re: Fw: Request for Permission of using instrument
To: Bushra Phd <bushraphd18@gmail.com>

Dear Miss Bushra,
You are welcomed.
Best
Eric

Bushra Phd <bushraphd18@gmail.com> 於 2019年7月9日 週二, 18:38 寫道:
Thank You so much Sir;

On Tue, Jul 9, 2019 at 12:58 PM Eric Liu <lotem.ncu@gmail.com> wrote:
Dear Miss Bushra,
You can use it in your publication.
Best
Eric

學系所 <ncu3851@ncu.edu.tw> 於 2019年7月9日 週二, 14:14 寫道:

From: Jennifer
Sent: Tuesday, July 09, 2019 12:07 PM
To: ncu3851@ncu.edu.tw
Subject: Fw: Request for Permission of using instrument

親愛的小姐您好:

經與您聯繫，轉寄以下的信件给您，我們協助查詢論文題目如下:

Study of Mathematics Motivated Strategies for Learning Questionnaire (MMSLQ) for Grade 10-12 Taiwan

作者有兩位，但不知是不是為劉教授（訓練與教學研究所）。

Eric Zhi-Feng Liu - Zhi-Feng Liu

若為劉教授是否方便協助轉給劉教授呢？

謝謝您了，非常感謝您的協助。

Best Regards,
Jennifer

******************************************************************************

APPENDIX -K
From: Bushra Phd [mailto:bushraphd16@gmail.com]
Sent: Monday, July 8, 2019 8:34 PM
To: ncucc@cc.ncu.edu.tw
Subject: Request for Permission of using instrument

Respected Eric Zhi Feng Liu,
Graduate Institute of Learning and Instruction
National Central University.

Sir, how are you? Bushra is here from Pakistan. I am doing Ph.D in Education from University of the Punjab. Now, I am doing my research work. I read your article The Survey Study of Mathematics Motivated Strategies for Learning Questionnaire (MMSLQ) for Grade 10-12 Taiwanese. Sir, I need your tool of Mathematics Motivation Scale for my research. I shall be very thankful to you if you grant me permission to use this instrument for my research work. Kindly email me tool of Mathematics Motivation with scoring. I shall be very thankful to you. My all research work will be wasted without getting your permission for using your tool of motivation. Please Sir kindly give me permission in order to use this tool. I am waiting of your reply.

Yours Truly,
Miss Bushra Naz
Ph.D Scholar,
Institute of Education and Research,
University of the Punjab, Pakistan.