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# Identification of Mathematics Best Teaching Practices in Pakistan

**Dr. Gulnaz Hameed[1]*, Dr. Ayesha Batool[2], Dr. Sheeba Zafar[3], Dr. Sehrish Khan[4], Iqra Malik[5], Hafiz Ghulam Murtaza[6]**

[1]*Assistant Professor, Lahore College for Women University, Lahore, Department of Elementary and Teacher Education, Email: gulnaz.hameed@lcwu.edu.pk
[2]Assistant Professor, Lahore College for Women University, Lahore, Department of Secondary Education, Emal: ayeshabatoolrana@gmail.com
[3]Assistant Professor, Department of Management Sciences, Shifa Tameer-e-Millat University, Islamabad, Email: sheebazafar.dms@stmu.edu.pk
[4]Assistant Professor. Department of Education, Lahore Leads University, Lahore, Email: dr.sehrishkhan.edu@leads.edu.pk
[5]School Education Department, Lahore, Email: iqramalik1410@gmail.com
[6]Lecturer, Department of Urdu, Lahore Leads University, Lahore, Email: ghulammurtaza.urdu@leads.edu.pk

***Corresponding Author:** Dr. Gulnaz Hameed
*Assistant Professor, Lahore College for Women University, Lahore, Department of Elementary and Teacher Education, Email: gulnaz.hameed@lcwu.edu.pk

**Abstract**
The purpose of this research was to examine current methods of mathematics education in Pakistan. With this goal in mind, researchers randomly selected 100 educators and 1,000 pupils from the Sahiwal area to participate. Beginning with semi-structured interviews, the study moved on to a survey of opinions, and finally included video recorded observations, all within a mixed-method approach. Researchers drew up a conceptual framework before developing questionnaires and collecting quantitative data in terms of collecting impressions based on patterns observed in interviews and compared to previously published literature and studies. Researchers coded and analyzed the qualitative data using content analysis techniques, and then used descriptive statistics to find out how many people agreed or disagreed with the practices and how often they were utilized in regular classroom instruction. Teachers and students alike filled out several survey forms to compile numerical data. In order to gather qualitative data, we first interviewed educators and then compared their actual pedagogical methods with those of their pupils. Serious discrepancies between perception and reality were shown by the study's results. The study's findings about mathematics education in Pakistan are deeply concerning. One of the best practices or standards for learning is meeting the needs of the kid in terms of their learning instruments, which include reading, writing, arithmetic, problem solving, and oral expression, as well as their learning contents, which include information, abilities, values, and attitude. It was recommended to improve mathematics education in Pakistan, it is crucial to evaluate the implementation of the National Curriculum Mathematics of 2006 and single national curriculum across diverse school settings, identifying gaps and barriers. Investigating the impact of sustained professional development on teachers' instructional practices will enhance their ability to engage students effectively. Additionally, comparing urban and rural teaching practices, emphasizing student-centered learning, and utilizing formative assessment techniques can provide insights to elevate overall educational outcomes in mathematics.

**Keyword:** Mathematic education, teaching practice, secondary education, best practices, National Curriculum

## Introduction

All countries, Pakistan included, are making efforts to change their educational institutions in a way that improves the quality of instruction (Jamil, Bokhari & Iqbal, 2024). Several agreements are being made, such as enhancing the curriculum and providing instructors with ongoing professional development opportunities both during and before their employment. The use of modern technology and other material resources in innovative ways by educators is strongly promoted in order to raise students' capacity for learning (Ali & Shah 2023).

Curriculum development has been an endeavor of the Ministry of Pakistan in collaboration with provincial administrations. Now that the curriculum has been revised, it is being delivered to the schools to be implemented. Students' capacity for conceptualization, theoretical knowledge, and critical thinking are given greater weight in the redesigned mathematics curriculum (Sharma, 2020).

Therefore, in order to improve students' conceptual understanding, math educators must change the way they now teach the subject (Jamil et al, 2024; Sharma, 2020). In addition, you must be willing to accept changes that are made to the current mathematics curriculum. The new mathematics curriculum (2006) proposed that Teachers are now expected to do more than just "administer data." They should be creating inquiry-based projects, keeping an eye on classroom conditions that foster productive learning, and guiding students to use their imaginations to arrive at an objective comprehension of mathematical ideas. In light of this, the proposed changes to the curriculum aim to improve the conceptual learning, comprehension, and instruction of mathematics by today's educators (Bümen & Holmqvist. 2022).

Learning mathematics is a must if you want to sharpen your brain's reasoning and critical thinking skills (Hansson et al, 2021). It was the contention of prominent educators Herbert, Froebel, and Maria that human mathematics concentration is necessary for an individual's academic and social development (Yasoda, 2009). A strong foundation in reasoning, thinking, concept-based understanding, procedural knowledge, and critical thinking is essential for any mathematical area investigation, including physics, chemistry etc (Hansson et al, 2021).

There are many distinguishing features of mathematics, such as its own vocabulary and pictures that set it apart from other fields. It encompasses conceptual discussion. Math is challenging for kids to grasp because to its abstract nature, unusual language, and visual representations. Some problems that students have when studying mathematics are related to teaching (Cardino & Cruz, 2020), especially when a single instructor is in charge of the class. Problems with mental weakness and extreme weariness, difficulty responding, not having enough interest in the subject to inspire the necessary mental efforts, and not keeping up with the instructor's composition speed are all things that students may experience while working on mathematical problems. Because they lack the necessary resources (time, energy, information, and student relationships), instructors working alone often struggle to effectively address a wide range of issues (Khan et al, 2020).

It is possible to fully divide Pakistan's educational system into two branches: compulsory education (elementary, middle, and high school) and tertiary education (college and university). School districts in the United States are divided into two types: public and private. Public schools educate students in grades I–V, while private schools educate students in grades VI–VIII (Khan, 2020). Finally, secondary schools educate students in grades IX–X (Jamil, Bokhari & Iqbal, 2024). The Regional Boards Examinations administer the secondary school certificate test to students in grades nine and ten. In addition, students in grades I through VIII are required to take mathematics. The course content is often organized into five main areas: mathematics and related activities, estimate, geometry, data processing, and algebra (Abbas et al, 2022).

Group studies in the arts and sciences are available to students in grades 9 and X at the secondary level. The first one draws from a wide range of scientific disciplines, including chemistry, biology, and physics, as well as advanced mathematics with an emphasis on calculus, capacity, and trigonometry). The latter offers a variety of math and science classes with a focus on basic arithmetic and less on more advanced topics like trigonometry, capacity, and polynomial calculus (Bhatti & Chaudhary, 2023). Whatever the situation may be, the policy efforts modified in 1995–1996 mandated that both groups follow the same secondary school mathematics curriculum. It is the responsibility of the elected government in Pakistan to formulate policies, especially educational policies, and to establish the essential guidelines. The majority of policy efforts are carried out by the province governments. However, in 2001, these responsibilities were transferred to the district level administrations (Khan et al, 2020). The federal ministry of education is responsible for curriculum development and formulation, which it shares with the provinces via their respective education offices in a reviewed system. Five overarching themes have been retained in the 2006 National Curriculum to allow for flexible interpretations. The following are some indicators: I) Operations with Numbers, II) Algebra, III) Geometry and Estimations, IV) Processing Data with, and V) Consistent and Reasoning-Based Thinking. This last change is significant because, as previously reported, it would allow for a focus on national educational goals and establish criteria for the advancement of numerical reasoning, both of which are essential for effective education (NCM, 2006 p. 2-3). Rather than constructing knowledge, a single Pakistani teacher would often employ a deductive approach of education that focuses on passing on existing information to their students. In the past, math classes in the arts would just go over the material without making any connections to real-world applications. The teachers there started class by going over some basic formulas and reminding the pupils to keep them in mind for when they need to solve certain numbers. There is a lack of collaboration among math instructors when it comes to sharing ideas and strategies for the classroom. instructors of mathematics may improve their own instruction (Woods & Weber, 2020) but they can also help their pupils succeed academically by working together with other instructors. Based on their greater research expertise in mathematics education, Bümen & Holmqvist (2022) argued that teachers' conceptual clarity is the starting point for every effort to improve mathematics instruction and learning standards. No progress or improvement will be made in mathematics classrooms until instructors' expertise about mathematics teaching and learning is investigated (Johnson et al, 2020), who agreed with this viewpoint. According to several studies (Oonk, Verloop & Gravemeijer, 2020; Hansson et al, 2021; Coffey & Sharep, 2023), teachers' views, concepts, and knowledge substantially influence their conduct and, in the end, their methods of instruction, which is a major factor in this.

According to Suurtamm (2022) the curriculum reform initiatives that have been implemented so far have likely been unsuccessful due to teachers' unquestioned biases and assumptions on the subject matter. So, rather than debating the optimal method of instruction, Molina et al (2020) stated that discussions on mathematics education had to center on the subject's norms and character. First things first: settle the mathematical disagreements among secondary school educators. Consequently, new curricula must be introduced while simultaneously urging educators to reevaluate their preconceived notions on mathematics, its standards, teaching methods, and student achievement if we are to see a shift in teachers' perspectives and pedagogical practices (Ali & Shah, 2023).

In light of the importance of mathematics education in Pakistan, this study seeks to provide the groundwork for future research by investigating the current state of mathematics education in the country and then comparing it to best practices.

**Classroom Environment and Learning Mathematics**

From a different angle, many educators now see mathematics proficiency as a critical area for professional development. There are two angles from which to view the problems with mathematics education: the societal and the individual (Ali & Shah, 2023). Learning conditions are considered from a social perspective; this seems to validate the correlation between these factors and students' intelligence and consequential outcomes (Daud, 2020).

The three most important classroom environmental factors are temperature, lighting, and noise reduction (Mughal, Asad & Adams, 2020). In addition to the standard learning atmosphere that was examined by Rind & Mughal (2020), the ideal learning environment is one that provides learning components such as furniture, ventilation, and comfort (Abbas et al, 2022).

Regardless of the fact that Salman (2023) found that the optimal atmospheric state varies across countries and across time. Whatever the case may be, some studies have shown that certain aspects of students' learning conditions have a significant impact on their mathematical academic accomplishment (Amirali & Halai, 2021).

Classroom climate discussions stand out within contemporary education systems, which advocate strong connections between classroom climate and student accomplishment, despite the billions of dollars spent and several improvements to K-12 instruction (Khan, Chachar & Abro, 2020). Subjective data about students' perceptions of the classroom setting and the impact of discernment encounters on their learning was handled in an inductive report by Gentilucci and Gentilucci (2016). Center school students from three different groups were surveyed using longitudinal social event data over a 34-year period: (a) Accomplice 1 (from 1979 to 2000) and (c) Companion 3 (from 2013). We looked into the data collected from the last two parties to see if, how, and why students' perceptions of classroom instruction evolved over time.

According to the results, the most important elements influencing students' ability to learn were teacher characteristics, classroom training, instructional techniques, and the amount of testing included in the curricula. Salman (2023) examined students' perceptions of their classroom environment and another study that examined the connection between classroom climate and student performance also examined the possible impact of praise on students' performance. Students' views of their classroom environment were also examined in relation to gender and grade level in the survey. To analyze the data, researchers used multivariate assessment of change (MANOVA) methodologies and connection studies. A final assessment of the classroom environment found that it was positively associated with student achievement. There was a factually significant correlation between the review level and the discernment, but no measurably enormous relationship between gender and students' perceptions of the classroom atmosphere.

Cardino & Crujz (2020) compared low- and high-performing schools in the United States in an effort to uncover the relationship between atmosphere and low-performing schools. Regarding the facts, there was no difference between the Admirable and Adequate schools. The results of this study suggest that pupils would do better on standardized tests if they were to attend schools that provided them with better learning environments. According to Adnan et al (2021), who studied the correlation between classroom climate, reading motivation, and accomplishment, students' performance on achievement tests improved in proportion to their confidence in the classroom's organization and structure. The factual criticality and clear identification of request and link with student achievement were both highlighted.

Two seventh grade classrooms in the East Drift region of the United States that receive funding from the federal government were the subjects of the inquiry. Following the administration of a standard evaluation, participants completed a classroom environment and reading motivation survey. Through the reading inspiration intermediaries of style, test, adequacy, and consistency, the study's findings established a correlation between better test scores and more prominent saw request and association, instructor support, and an alliance. Fifth and sixth graders were the subjects of an experiment by Oonk, Verloop & Gravemeijer, (2020) that aimed to dissect the relationship between an enthusiastic classroom environment and academic success. The purpose of the test was to gain a better understanding of the powerful associations that students form in class and how those associations impact their academic performance. Perceptions in the classroom, student reports, and report card ratings were all part of the assessment. Students' active participation influenced the favorable correlation between an effective classroom environment and academic performance, according to a multilevel analysis.

The classroom's hierarchical and instructional climates, as well as teachers' opinions of them, were examined. Connectedness and belongingness, joy and enthusiasm, and esteem were the defining characteristics of both high- and low-energy classroom environments. Students are more likely to be engaged in learning and produce substantial academic progress when they rank the classroom passionate atmosphere higher. A sample of 420 secondary school students served as the basis for the test. The findings showed that personal and familial preferences predicted academic success. The study highlighted the need of giving students the opportunity to practice relaxation and care techniques in order to improve their academic performance.

**Past Studies on Present Scenario**

Math is an essential topic. This is taught in all Pakistani public and private schools from the first to the tenth grade. According to several sources (Jamil, Bokhari & Iqbal, 2024; Akhtar & Saeed, 2014), mathematics is the most important subject taught in secondary school. According to many sources, such as NCERT (2006), Sharma (2020) and the Sharif Commission (1959), this subject is enormous. Several Indian commissions and reports, including the 1937 Zakir Hussain Committee, the 1952 Secondary Education Commission, and the 1964 Kothari Commission, all placed a heavy focus on mathematics education in primary and secondary schools (Bhutto & Rind, 2022). Mathematical education is a staple in Asian countries' curricula, especially in East Asian countries (Saher, 2020; Sharma, 2020). Another interesting thing that has happened as a result of this special attention is the outstanding performance of these countries' pupils on the modern international exams that have been administered over the past 20 years (Daud, 2020).

The extension of these nations' economic development over the critical decade of this century is another evident enticing systematic component (Shah, 2023). Many students in Pakistan's tuition-based institutions view mathematics as a chore rather than an opportunity for personal growth, and many more pupils publicly voice this sentiment. All the way through secondary school, students in Pakistan learn mathematics, and this subject calls for focused effort, clear thinking, and a positive attitude (Aslam et al, 2021).

Teachers sometimes fail to educate and develop these crucial abilities in children in various Pakistani assembly and fee-based schools. As a result, many pupils are still ill-equipped to form any kind of connection to the topic even after graduating from high school (Khan et al, 2020). As a means of evaluating their students' progress, teachers often have them purposefully apply what they've learned in class to real-world situations (Amirali & Halai, 2021; Bhatti & Chaudhry, 2023). According to Bhatti & Chaudhry (2023), one of the main components of learning mathematics is being able to recognize the answers to

mathematical problems. Formulas are memorized by students without their realizing the significance of the why and how behind it.

Model public sector schools in Pakistan have poor mathematics preparation for a variety of reasons. Specifically, students' inability to grasp mathematical concepts is influenced by factors such as teachers' lack of subject-specific knowledge, teachers' ineffective teaching abilities, and the relative weight that students and teachers give to mathematics (Amirali & Halai, 2021). Students in Pakistan who demonstrate proficiency in mathematics will be reflected in the new national curriculum, which is based on three broad categories of activities. Knowing and utilizing mathematical facts, actually doing mathematical operations, and thinking about mathematical solutions all fall within this category (Mangi, Rind & Nindwani, 2023). In most mathematics classes in Pakistan, particularly in Punjab, there is a large gap between the desired curricular destinations and what really occurs, according to the overall concept of the existing system.

**Theoretical Framework**

Model public sector schools in Pakistan have poor mathematics preparation for a variety of reasons. Amirali & Halai (2021) identified many factors that hinder students' mathematical knowledge, including instructors' lack of subject-based learning, instructors' weak instructional competency, and students' and instructors' opinions of the value of mathematics. The new mathematics curriculum in Pakistan's national schools is based on three broad categories of exercises that illustrate the core competencies of pupils with strong mathematical ability. Knowing and utilising mathematical facts, actually doing mathematical operations, and thinking about mathematical solutions all fall within this category (Salman, 2023). In most mathematics classes in Pakistan, particularly in Punjab, there is a large gap between the desired curricular destinations and what really occurs, according to the overall concept of the existing system.

**Problem statement**

Mathematical ability is not much sought after in Pakistan (Jamil et al, 2024). Previous research has shown that pupils are not getting a solid foundation in mathematics (Dilshad & Shah, 2023). The pupils lack solid foundational understanding of mathematical concepts. Therefore, kids' abilities are not being developed in the classroom. Learning and teaching mathematics at the secondary level presents a number of challenges. Efforts and funds from the government are going into it. To this day, we have not caught up to the amount of mathematical competence that pupils should possess. Teachers have a crucial role in helping pupils acquire mathematics in the classroom, and the state should recognize this (Mangi, Rind & Ninwani, 2023). Thus, questions like: how do math teachers recognize the significance of and implement effective instructional procedures to promote student learning? what are the most common challenges that students encounter on a daily basis in math classes? and what immediate, informative solutions do teachers use to help students overcome these challenges?

Public and private secondary schools in Pakistan are the focus of this study, which aims to investigate mathematics education policies and pedagogical approaches, as well as student learning preferences.

This study defines the pedagogical approaches employed by both public and private schools in Pakistan. Also, find out where Pakistan is falling short in comparison to best practices in education. Also looking into the many approaches that students take to improve their math skills. Preparing our pupils for the future of our nation via mathematics education is of the utmost importance.

**Research objectives**

The objectives of this research are to:

1. Determine where secondary school mathematics education currently falls short of what is considered to be best practice.
2. Determine the disparity between the best practices for teaching mathematics in secondary schools and the methods currently used.
3. Compare and contrast the methods used by public and private schools to teach and learn mathematics.

**Research Questions**

The questions to be inquired in the light of above-mentioned objectives are:

Q.1. How does the way math is taught now compare to what is considered to be the best method for teaching the subject in secondary schools?

Q.2. How are the most effective methods of teaching mathematics in secondary schools different from the ones now used?

Q.3. How do secondary schools in the public and private sectors approach the teaching and learning of mathematics?

**Research Significance**

The purpose of this study is to examine math education in Punjab, Pakistan, specifically looking at public and private secondary schools, with a focus on math instruction and learning styles. It would be very interesting to see how these approaches compare to the standards outlined in policy documents, research, and math curricula.

Sadly, there is a dearth of mathematically gifted students in Pakistan. Results from tests and other recent studies show that most students either did not pass this class or got just average or below-average marks. Consequently, this is a very critical issue to identify. Important implications for educational theorists, policymakers, classroom teachers, and teacher educators emerged from this analysis. Based on the results of this study, math education programs may be well-designed. School districts are not using innovative strategies for mathematics education, as our investigation made very obvious. In light of the findings of this inquiry, policymakers would then be able to devise more effective measures to address this issue.

Mathematical subjects were not given the necessary emphasis in earlier educational practices. Researchers hope that policymakers will use the results of this study to gauge whether or not proposed reforms to the mathematics education system are both feasible and successful.

It should come as no surprise that the best way for math educators to be prepared to create capacity in their pupils is through the methods and tools covered in teacher preparation programs. The most recent advances in globalization need the improvement of these programs to meet the evolving needs of the public. By doing so, they would be able to identify the actual discrepancy between the mathematical practices as they are currently and the practices recommended in the literature study. Implementing a consistent educational framework in Pakistan might benefit from the study's insights and recommendations. The results provide light on the challenges that students have while trying to grasp mathematical concepts, which can help math educators choose the most effective methods of instruction. Teaching mathematics effectively and helping students learn more is an important topic to include in both pre-service and in-service teacher education programs.

**Study Delimitations**

This examination was delimited to secondary schools in district Sahiwal

**Research methodology**

In order to answer the study questions, a mixed-methods technique was adopted. A mixed-methods approach was used in the design. To gather information from math classes, the researcher employed a combination of survey questionnaires, interviews with math professors, and video recording techniques.

**Population and Sample**

The research included all secondary school math teachers and pupils in Punjab, including public and private. In the initial step, 100 secondary schools, both public and private, were selected at random. Fifty public schools and fifty private schools from the urban and rural areas of district Sahiwal were also included in the sample. The research included both classroom instructors and their pupils. The study's primary focus was on secondary school mathematics education and achievement disparities.

In addition, 25 public secondary schools for boys and 25 public secondary schools for girls were identified. The same procedure was used to choose 25 male and 25 female students from private secondary schools. From these schools, we gathered responses from math teachers and students. The second step involved employing systematic selection procedures to choose ten pupils from each instructor.

**Research Instrument and Pilot Testing**

Two surveys were developed: one for educators and one for students. Teachers' and students' perspectives on mathematics education were the building blocks of this survey. Interviews were carried out with educators by the researcher. The observation of math classes was also documented using video capturing methods.

In order to ensure that the questionnaire was valid and reliable, it was pilot tested. A reliability coefficient of 0.807 was determined, indicating that the instrument was dependable for the inquiry, after its initial trial with students and instructors from five secondary schools (both public and private) that were not included in the actual study.

**Data Collection and Analysis**

The data was collected from both the students and the teachers' using interviews and survey questionnaires. Classroom observations were carried out by video capturing the actual teaching and learning sessions that were taking place at the time. While descriptive and inferential statistics were used to examine quantitative data, meaning was derived from themes, categories, patterns, and regularities in qualitative data.

The study was conducted in three stages, with data collecting occurring in each phase and analysis following immediately after. The teachers were interviewed in a semi-structured manner for the first phase. It was carried out to compile the study's components and sub-components as well as a foundation for the questionnaire's finalization in light of the circumstances that have been gathered and are currently in place in the Sahiwal district with regard to the teaching and learning of mathematics in secondary school classrooms. With the aid of survey questionnaires from teachers and students, the second phase involved the quantitative data collecting. Teachers were questioned about the practices they employ in the classroom, and students validated these answers with information from real-world scenarios. The last stage was watching live as courses were conducted in order to compare and contrast the scenarios that were actually occurring in Sahiwal secondary school classrooms with the narratives that the instructors had previously presented.

As soon as each phase was finished, it was all concurrently analyzed. in order to obtain the outcomes that will be beneficial to the other stage. Thematic analysis was used for video conferences, descriptive statistics were computed for quantitative data, and semi-structured interviews were examined using phenomenological interpretive analysis style.

**Data Analysis and Interpretation**
**PHASE I**
**Research Question No. 1 and 2**

**Table. 1. Coded Interview: Best Teaching Learning Practices in Teachers' Views in Interview Question #8**

| Categories | Responses |
|---|---|
| Best Teaching Practices in Teachers' Views | • Solving problems;<br>• working in groups;<br>• projected demonstrations;<br>• conceptual comprehension;<br>• drills and practice;<br>• worksheets;<br>• unexpectedly brief exams |
| Best Learning Practices in Teachers' Views | • Conceptual learning;<br>• unfamiliar questions;<br>• practice;<br>• delivering blind exams;<br>• studying via online tutorials; |
| Application of these best practices in classes | • Lack of time to follow;<br>• a large student body;<br>• occasional ability to grasp simple lectures;<br>• emphasis on numerical marks;<br>• provision of conceptual understanding;<br>• Choose to work on practice issues;<br>• Worksheets are utilised occasionally;<br>• On-board assessments are typically brief. |

Every participant, whether they were in the public or commercial sector, aimed to consider the best methods for teaching mathematics. The majority of them explained that group projects and problem-solving strategies were the best ways to teach mathematics. However, others claimed that regular drill and practice were also necessary and that having a conceptual knowledge of each lesson's material and sum-solving techniques was crucial. A teacher at a private school catering to the upper class explained that projecting the video instructions onto the pupils' whiteboards would be a more suitable method. The remaining private school teachers expressed a preference for using worksheets and quick tests as an effective way to teach mathematics. Regarding the best learning strategies, teachers explained that students should practice summations, make their concepts clear, give their parents blind tests, or even use the internet to view YouTube tutorials for simple and alternate solutions.
According to a senior public sector mathematics instructor, when asked about the application of these best practices, everyone responded that they could only provide conceptual knowledge, use whiteboard demonstrations of solutions, administer rapid examinations, or assign homework that required students to drill a sum five times at home.

**Research Question No. 3.**
What are the differences in mathematics teaching and learning techniques between secondary schools in the public and private sectors? is the study's final research question. Every interview question that came before it included an analysis of this research question. However, a succinct but thorough comparison is provided in this section.

**Table. 2. Comparison of the Public and Private Schools Practices as Indicated in Interviews and Video Recordings**

| Public Sector Practices | Private Sector Practices |
|---|---|
| ***Lecture Preparation*** | |
| • Most have high levels of subject-matter competence;<br>• most don't bother to prepare | • Preparing or verifying lessons for the class;<br>• mostly in the process of developing expertise |
| ***Teaching Methods*** | |
| • Talk;<br>• Board demonstration;<br>• Drill and practice | • Drill and practice;<br>• lecture;<br>• board demonstration;<br>• large group work |
| ***Material Resources*** | |

| | |
|---|---|
| • Reference books,<br>• textbooks,<br>• and geometrical instruments | • Worksheets;<br>• textbooks;<br>• geometrical instruments |
| ***Learning Strategy*** | |
| • Exercise<br>• Conceptual Knowledge<br>• Students assist other students | • Practice with assignments;<br>• Gain conceptual knowledge;<br>• Consult the teacher with questions |
| ***National Curriculum*** | |
| • Not truly cognizant of<br>• No NCM plan implemented | • Not truly cognizant of<br>• No NCM plan implemented |
| ***Perceptions about Best Strategies*** | |
| • Drill;<br>• Methods for tackling problems;<br>• Display;<br>• Group work | • Short assessments;<br>• Problem-solving techniques;<br>• Projected Demonstrations<br>• Workbooks and worksheets;<br>• Group projects |
| ***Reasons of not following best practices*** | |
| • Overcrowding in the classrooms;<br>• insufficient time to cover the course;<br>• ease and speed of traditional methods;<br>• inability to monitor every student;<br>• and one teacher teaching many maths sessions in one segment per day | • Small class sizes,<br>• a lack of time to cover the curriculum,<br>• adherence to the school's procedures,<br>• an attempt to watch every kid but inability to assist due to multitasking,<br>• and an excessive amount of additional school-related work |

**Phase II**

**Quantitative Data Analysis and Interpretation**

**Descriptive Analysis of Biographic Information**

Frequency percentages on the data supplied by the teachers were used to determine the descriptive analysis of the biographical information.

**Table. 3. Frequency & Percentage of teachers' biographic information**

| | | Frequency | Percent |
|---|---|---|---|
| Gender | Male | 45 | 45.0 |
| | Female | 55 | 55.0 |
| Gender | < 5 | 66 | 66.0 |
| | >= 5 | 34 | 34.0 |
| Qualification | BA | 16 | 16.0 |
| | MA | 64 | 64.0 |
| | Mphil | 20 | 20.0 |
| Professional Qualification | B.ed | 75 | 75.0 |
| | M.ed | 25 | 25.0 |
| Trainings | 0 | 27 | 27.0 |
| | 1 | 38 | 38.0 |
| | 2 | 33 | 33.0 |
| | 3 | 2 | 2.0 |

Respondents were split 45% male and 55% female. Sixty-six percent of the participants had fewer than five years of teaching experience, whereas thirty-four percent had more than five years. The instructors' professional qualifications were split between B. Ed (75%) and M. Ed (25%), while their academic levels ranged from B.A. (16%) to M.A. (64%) and M. Phil (20%). Additionally, it is evident from looking at the number of professional trainings they had that a larger percentage of participants (38%) had attended just one training, followed by a second majority (33%) who had attended two trainings, a small percentage (27%) had attended none at all, and a mere 2% had attended three trainings at all.

**Perception of Secondary School Teachers Regarding Mathematics Teachers' Teaching Practices**

Five-point Likert scales were used to capture the perceptions: 1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, and 5 = Strongly Disagree. The mean response values and standard deviations of the items were computed in order to analyse the collected perceptions. The range that follows was established as a benchmark to ascertain whether or not students' perceptions, based on the average response values for each item, were in accord. (Likert scale was arranged in reverse order, with 1 denoting strong agreement and 5 denoting strong disagreement).

**Table. 4. Mean Response Values of Each item.**

| *Range* | *Scale* | *Opinion* |
|---|---|---|
| ≥1.45 | Strongly Agree | Agreement |
| 1.46-2.45 | Agree | Agreement |
| 2.46-3.45 | Neutral | Uncertainty |
| 3.46-4.45 | Disagree | Disagreement |
| ≤4.46 | Strongly Agree | Disagreement |

**Division of Mean and variance among Teachers Regarding Best Practices Gap**

Mean and variance are derived for examining the gap among practices teachers' being used for teaching mathematics by using R software. The subsequent table and figures are presented below:

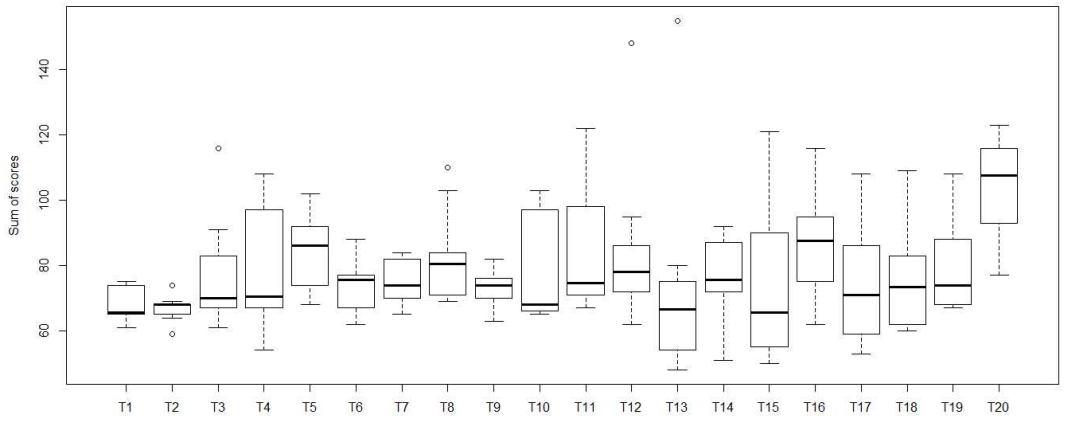



**Figure. 1. Best Practices Gap among 1 to 20 Teachers**

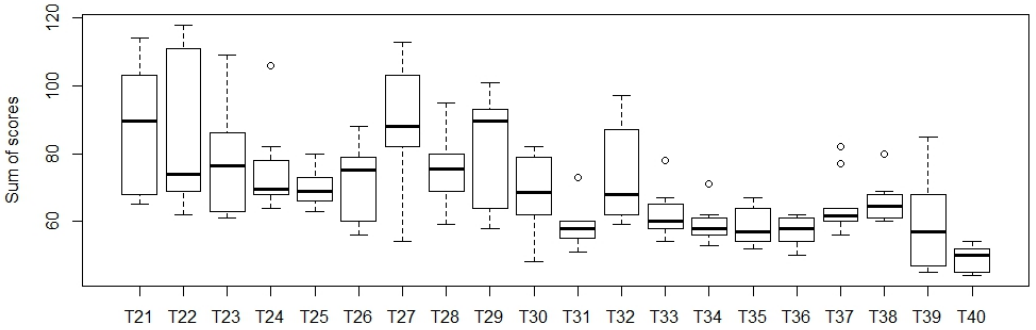



**Figure. 2.** *Best Practices Gap among 21 to 40 Teachers*

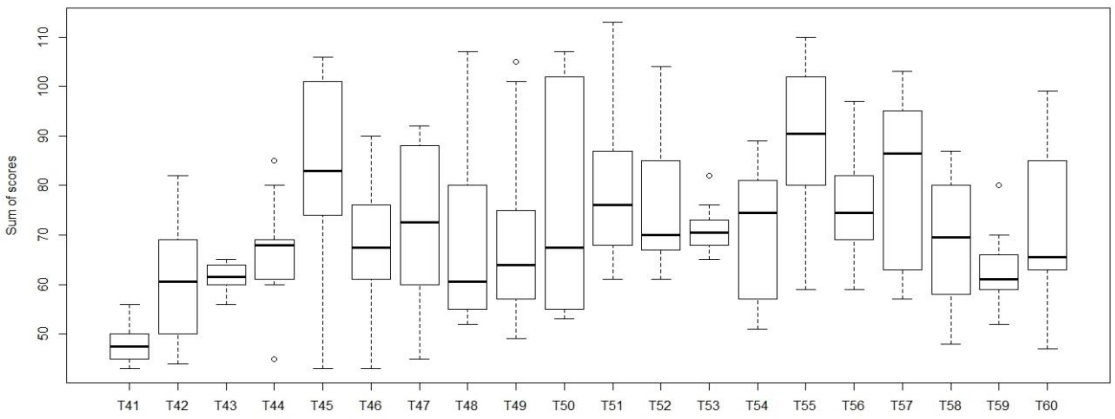



**Figure. 3.** *Best Practices Gap among 41 to 60 Teachers*

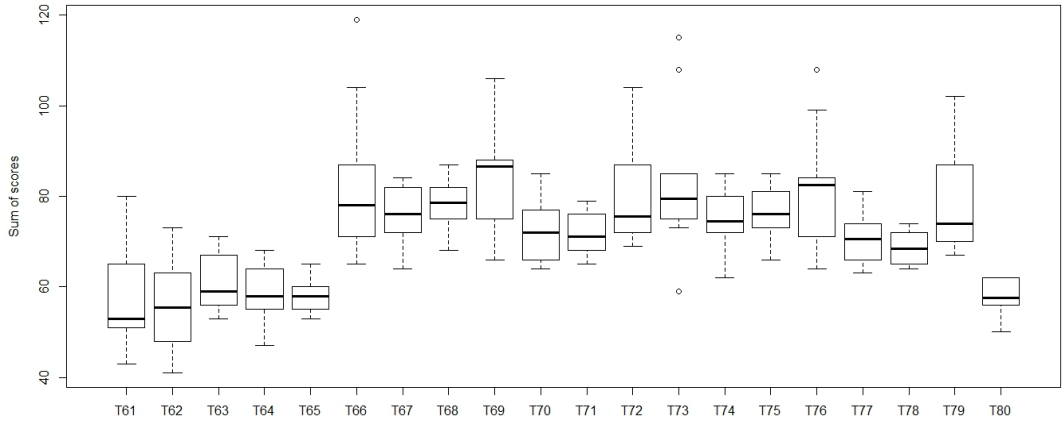
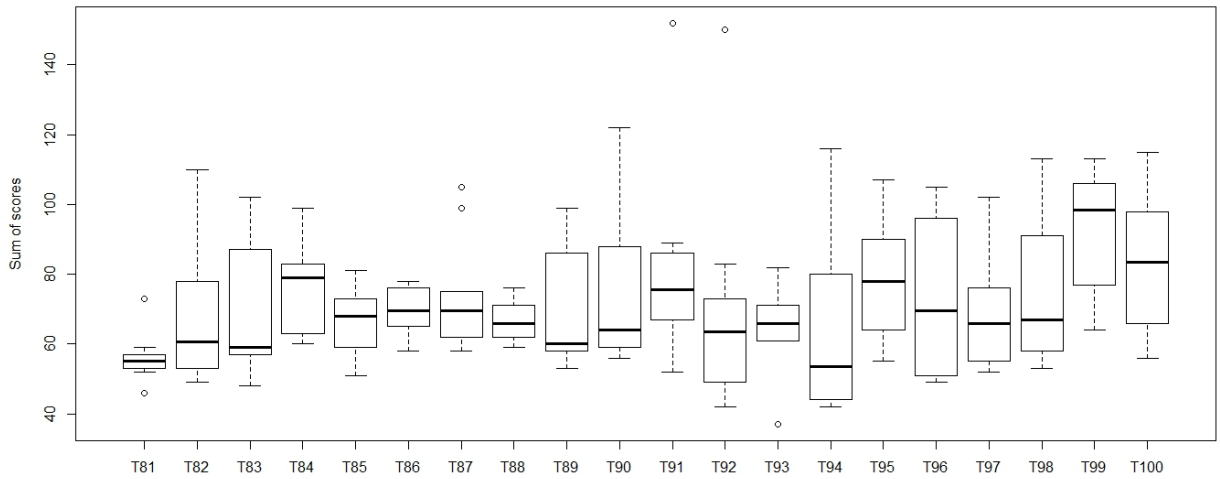



**Figure. 4.** *Best Practices Gap among 61 to 80 Teachers*




## Best Practices Gap among 81 to 100 Teachers

Based on the box plot, we may infer informally that, out of all 100 teachers, students of teacher "T41" believe that the majority of the approach's teachers use to help students improve their understanding capabilities are current and have a major positive impact on the students' experiences. We can also draw the conclusion that students exhibit a fleeting interest in the subject, which enables them to evaluate the teacher's chosen teaching methods. Thus, it is relevant to note that it is crucial to cultivate students' interest in and conviction in managing and planning class activities.

Based on the data in the box plot, we can infer that out of 100 instructors, students of "T41" think that their teacher uses modern methods to help them comprehend more and that these methods greatly improve their learning experience. It is also possible to draw the conclusion that students' transient interest in the material enables them to evaluate the efficacy of the teacher's pedagogical approaches. Therefore, it is relevant to note that it is crucial to foster students' interest and belief in managing and organizing class activities.

**Table. 5. Division of Mean and variance among Teachers Regarding Gap**

| T# | Mean | Variance | T# | Mean | Variance | T# | Mean | Variance |
|---|---|---|---|---|---|---|---|---|
| **T1** | 67.9000 | 4.95424 | **T35** | 58.8000 | 5.65292 | **T71** | 71.7000 | 4.71522 |
| **T2** | 66.8000 | 3.91010 | **T36** | 57.3000 | 4.24395 | **T72** | 80.5000 | 11.75916 |
| **T3** | 76.6000 | 16.60790 | **T37** | 64.4000 | 8.30261 | **T73** | 83.4000 | 16.52069 |
| **T4** | 77.4000 | 18.72135 | **T38** | 65.8000 | 5.92171 | **T74** | 75.0000 | 7.19568 |
| **T5** | 84.4000 | 10.63746 | **T39** | 58.5000 | 12.56317 | **T75** | 75.7000 | 5.77446 |
| **T6** | 74.8000 | 8.53490 | **T40** | 49.2000 | 3.79473 | **T76** | 81.9000 | 13.48621 |
| **T7** | 75.1000 | 6.83862 | **T41** | 47.8000 | 3.96653 | **T77** | 70.5000 | 5.48229 |
| **T8** | 82.7000 | 13.74409 | **T42** | 61.0000 | 12.37381 | **T78** | 68.8000 | 3.85285 |
| **T9** | 73.2000 | 5.90292 | **T43** | 61.6000 | 2.75681 | **T79** | 79.4000 | 12.67719 |
| **T10** | 76.8000 | 15.58347 | **T44** | 67.2000 | 10.91177 | **T80** | 57.8000 | 3.85285 |
| **T11** | 83.5000 | 18.42251 | **T45** | 80.6000 | 22.94535 | **T81** | 56.1000 | 6.93542 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **T12** | 84.4000 | 24.19458 | **T46** | 66.3000 | 13.44164 | **T82** | 67.8000 | 18.69522 |
| **T13** | 73.5000 | 30.54050 | **T47** | 71.9000 | 18.25407 | **T83** | 69.1000 | 19.07558 |
| **T14** | 76.7000 | 11.64331 | **T48** | 67.5000 | 17.65880 | **T84** | 76.6000 | 12.03883 |
| **T15** | 76.1000 | 26.01047 | **T49** | 70.1000 | 19.33017 | **T85** | 67.3000 | 9.63846 |
| **T16** | 86.0000 | 16.02775 | **T51** | 80.5000 | 18.03238 | **T86** | 69.2000 | 6.90893 |
| **T17** | 75.6000 | 19.58004 | **T52** | 76.2000 | 13.35665 | **T87** | 73.6000 | 16.01527 |
| **T18** | 77.5000 | 17.68395 | **T53** | 71.1000 | 4.99889 | **T88** | 66.4000 | 5.46097 |
| **T19** | 80.0000 | 13.85641 | **T54** | 71.7000 | 13.14069 | **T89** | 69.5000 | 18.12457 |
| **T20** | 105.000 | 14.80991 | **T55** | 87.9000 | 17.18171 | **T90** | 75.1000 | 21.74320 |
| **T21** | 89.1000 | 18.77025 | **T56** | 75.0000 | 11.07550 | **T91** | 81.2000 | 27.48252 |
| **T22** | 84.1000 | 21.12634 | **T57** | 81.1000 | 17.58440 | **T92** | 69.7000 | 31.12002 |
| **T23** | 79.2000 | 17.33205 | **T58** | 68.1000 | 13.37037 | **T93** | 65.6000 | 12.59806 |
| **T24** | 75.0000 | 12.36482 | **T59** | 62.5000 | 8.03119 | **T94** | 67.5000 | 28.89156 |
| **T25** | 69.9000 | 5.08702 | **T60** | 71.9000 | 15.61659 | **T95** | 78.2000 | 16.82459 |
| **T26** | 72.5000 | 11.77804 | **T61** | 57.0000 | 11.74734 | **T96** | 73.1000 | 21.41884 |
| **T27** | 88.4000 | 18.29511 | **T62** | 55.2000 | 9.73881 | **T97** | 67.6000 | 14.74374 |
| **T28** | 74.9000 | 10.95901 | **T63** | 60.7000 | 6.37791 | **T98** | 75.5000 | 21.55742 |
| **T29** | 81.9000 | 16.21008 | **T64** | 58.2000 | 6.97296 | **T99** | 93.7000 | 17.11432 |
| **T30** | 67.4000 | 12.09408 | **T65** | 57.9000 | 3.95671 | **T100** | 82.3000 | 20.08344 |
| **T31** | 58.4000 | 5.87272 | **T66** | 83.1000 | 16.86186 | | | |
| **T32** | 73.3000 | 13.76025 | **T67** | 75.7000 | 6.60051 | | | |
| **T33** | 61.8000 | 6.86052 | **T68** | 77.8000 | 5.95912 | | | |
| **T34** | 59.0000 | 4.98888 | **T69** | 84.6000 | 12.40251 | | | |
| **T35** | 58.8000 | 5.65292 | **T70** | 72.2000 | 6.89283 | | | |

**Summary of the Study**

The purpose of this research was to examine current methods of mathematics education in Pakistan. With this goal in mind, we randomly selected 100 educators and 1,000 pupils from the Sahiwal area to participate. Beginning with semi-structured interviews, the study moved on to a survey of opinions, and finally included video recorded observations, all within a mixed-method approach. Researchers drew up a conceptual framework before developing questionnaires and collecting quantitative data in terms of collecting impressions based on patterns observed in interviews and compared to previously published literature and studies.

Researchers coded and analyzed the qualitative data using content analysis techniques, and then used descriptive statistics to find out how many people agreed or disagreed with the practices and how often they were utilized in regular classroom instruction. Teachers and students alike filled out several survey forms to compile numerical data. In order to gather qualitative data, we first interviewed educators and then compared their actual pedagogical methods with those of their pupils. Serious discrepancies between perception and reality were shown by the study's results.

**Findings of the Study**

***Narrative***

The findings from the qualitative data according to research questions are as follows:

- Compared to excellent mathematics teaching approaches recommended in Pakistan's mathematics curriculum and other publications, secondary school mathematics teaching practices differ greatly.
- Compared to optimum mathematics learning strategies recommended in literature review, secondary school mathematics teaching practices differ greatly. With regard to mathematics teaching and learning techniques, neither secondary school sector was determined to be flawless or up to standard; rather, both sectors have shortcomings and disparities in the way the lessons are delivered and learned.

***Teachers' related findings***

(As Likert Scaling of the responses was in reverse order i.e., 1: Strongly Agree, 5: Strongly Disagree).

- The total mean value of the factor instructors' methods for teaching math skills is at the agreement level (M=2.1591, S.D =.31660).
- In teaching math's, most instructors felt that they help the pupils have a conceptual grasp of the subject.
- The component regarding effective instruction for pupils to acquire mathematical abilities has an overall mean value of agreement (M=2.0282, S.D =.35755).
- Most professors often create equations and functions to show linkages, provide alternative approaches to problem-solving when necessary, and include students in class discussions.
- The factor concerning the availability of material resources for enhancing arithmetic abilities has an overall mean value of 2.3264, S.D.=.59649.
- Most of the instructors say that there is frequently computer spread sheets and teachers' guides for teaching math's.
- The items generated an overall mean value of factor usage of material resources of (M=2.4327, S.D =.10505).
- Most of the instructors say that calculators and the teachers' handbook are often used in math's courses.
- The overall mean value of the instructional strategies they often used to teach maths was (M=2.2867, S.D=.5335).

- Teaching mathematics by demonstration technique was ranked second, while discussion approach was ranked top.
- Additionally agreeing was the overall mean score (M=2.1420, S.D =.54609) for the Evaluation Techniques component.
- The greatest priority for assessment is the exams, which are given according to the school's established standards. The second, and often utilized, evaluation technique in schools is the class question and answer period.

***Students' related findings***

- Additionally strongly agree to agreement is the mean value of the opinions of the mathematics subject (M=1.9111, S.D=66392).
- The respondents highly value teachers' teaching approach and are inspired to solve more problems after solving one. Second highest, according to the students, is learning maths to receive good results.
- In accord were the students' perceived teaching approaches (M=2.1196, S.D=.60431).
- It was strongly agreed by the students that the mathematics instructor explains the goals and significance of each class in detail.
- For mathematics learning practices, students' mean learning activities during class were (M=1.8132, S.D=.49160).
- Most of the students felt that in order to know what kids are learning, mathematics professors should frequently ask them whether they understand. Including every student in the lecture is a second often utilized technique. Thirdly, the impression among students was that professors always made every effort to provide simple substitutes for challenging issues. One common method to help kids grasp any idea is to use both a black and white board.
- M=2.0417, S.D=.57597 was the mean score of the evaluation for learned math's.
- The pupils strongly agreed that the mathematics teacher promptly reviews exam results. The second typical method of evaluation is the monthly and weekly test. The third highly regarded habit among the students is evaluating your present knowledge before beginning a new subject.

**Conclusion of the study**

In light of the study's aims and results, it will draw a conclusion about mathematics education in secondary schools. The study set out to do the following: (1) catalogue existing mathematics teaching and learning practices; (2) compare public and private school mathematics curricula; and (3) determine whether there is a significant difference between the methods currently used in classrooms. In accordance with each goal, let us end our research:

***In order to determine where secondary school mathematics education currently falls short of what is considered to be best practice***

According to the findings, following are the gaps identified by the researcher:

- Educators try harder but don't always succeed.
- Contrary to what was said, teachers did not really implement problem-solving techniques of education in the classroom.
- Why Despite several educators promoting conceptual comprehension as the gold standard in mathematics education, students often did not grasp these ideas in class.
- Mathematical classes heavily utilise discussion and demonstration approaches, according to the instructors' poll.
- According to qualitative narrative, arithmetic instruction that focuses on drill and practice is ineffective. Nevertheless, this is what teachers tend to focus on.
- Despite teachers making sure students knew the lesson's goals and how it will apply to real life, this was not occurring in actual classrooms.
- The majority of Pakistani educators have not bothered to examine the curriculum document, textbook goals, or national educational policies, which are considered to be the gold standards in the country.
- There is a large gap between instructors' perceptions of their classes and what students experience there, and teachers do not emphasize the significance of various math's topics to their pupils.

***To determine the disparity between the best practices for teaching mathematics in secondary schools and the methods currently used.***

Disparities between optimal and actual knowledge gained from qualitative and quantitative research include:

- Students did not grasp concepts at a conceptual level;
- Instruction did not take into account students' unique learning styles;
- Students were overworked in class and homework;
- They rarely asked more questions than necessary;
- No resources were available to help students learn mathematics; and
- Drill and practice dominated the curriculum i.e., What was observed in classrooms and what students perceived differed significantly.

***To compare and contrast the methods used by public and private schools to teach and learn mathematics.***

Following gaps can be found out between the two sectors:

- The mean value for private schools showed in the teacher questionnaire that there was a substantial difference between public and private schools in terms of effective students' instruction.

- When compared to private school pupils, public school students have a clearer picture of how others feel about mathematics.
- Compared to private school pupils, public school students have a more positive outlook on how math's is taught in the classroom.
- Why Students in public schools tend to have a more positive outlook on math's education than their private school counterparts.
- When comparing public and private school pupils, the former has a more favorable impression of how math's knowledge is assessed.
- Teachers in the public sector tend to be more educated and more seasoned than their private sector counterparts.
- The goal of private education is to help pupils develop a solid conceptual framework.
- The large enrollment in public schools makes it difficult to cater to each student's unique learning style.
- The public sector, on the other hand, has a very dedicated student body when it comes to grades.
- The primary goal of most educators in public schools is to help pupils better understand complex ideas.
- Students in the private sector were instructed to use guidelines to tackle homework tasks.
- There is a significant difference in the number of pupils per classroom between public and private schools.
- Unlike their private school counterparts, public school teachers don't get many opportunities for professional development, with the exception of annual summer sessions.

**Discussion of the Study**

The study's findings about mathematics education in Pakistan are deeply concerning. Meeting the learning requirements of the child, which comprise learning tools (literacy, numeracy, problem solving and oral expression) and learning contents (knowledge, skills, values and attitude), is one of the best practices or standards for learning as illustrated in NEP (2009; 2006). Alternatively, the general mathematics classroom situation and its solution are outlined in Pakistan's national curriculum of mathematics and can be considered best practices as consistent with the findings of Jamil, Bokhari & Iqbal (2024).

National Policy and Curriculum Documents make it clear in National Curriculum Mathematics (2006) that best practices standards do not include drill, practice, or memorizing without grasping the conceptual background of the questions/lessons. To that end, building on the work of Kilpatrick et al. (2001), NCM (2006) outlined five distinct approaches to education that span the gamut from basic facts to advanced skills. The following is a tabular representation of the strategies:

**Table. 6.** *Strategies vs. Skills for mathematics best practices*

| *Sr.* | *Strategy* | *Skills* |
|---|---|---|
| 1. | Conceptual understanding | For mathematical concepts, operations and relations |
| 2. | Procedural Fluency | For Skills for doing sums perfectly with fluency |
| 3. | Strategic Competence | For Aptitude for solving mathematical problems |
| 4. | Adaptive reasoning | For Ability to think, explain and justify logically |
| 5. | Productive disposition | For seeing mathematics as important and essential in progress and success of life |

The mathematics national curriculum states that mathematicians enrich their classrooms, encourage their students to actively participate in mathematical debate, and use their students' questions and comments to build upon and expand upon mathematical links. They don't only provide definitions and detailed instructions for pupils to memorize without providing context for why these things are important. If children are to develop their own conceptual grasp of mathematics, teachers will need to take on a different role. Teachers should not only regurgitate mathematical facts into their pupils' brains, but rather foster an engaging classroom climate that promotes mathematical learning through heightened student engagement as consistent with the findings of Dilshad & Shah, (2023).

Contrary to conventional wisdom, mathematics education requires paying close attention in class, gauging each student's current level of comprehension, assigning an assignment, and then analysing the results to deduce how the pupils understood the material. Rather than just relaying facts and figures, teachers now need to scaffold their students' creative problem-solving, foster an atmosphere of cooperative learning, and organise their students' exploratory assignments. As part of this enhanced method of instruction, teachers should focus on the following areas of their work with students as consistent with the findings of Mughal, Asad & Adams (2020).

The key reason instructors aren't using any of the tactics that were included in the mathematics-based educational policy documents is that they aren't aware of them, according to this study. Or, even if they are, they show little dedication to the

subject of their chosen educator. In order to help their pupils, learn mathematics effectively, teachers should act as facilitators, negotiators, organizers, planners, and mediators (NCM, 2006). Although the problem-solving method of instruction is supposedly the gold standard as outlined in NCM (2006), the present situation makes it abundantly evident that even this practice is too little to be considered significant.

According to the quantitative data collected from the teachers, math teachers made a difference in three areas: instructional technique, evaluation techniques, and the availability and use of resources. However, they had no impact on students' instructions or effective teaching practices. This condition prompts the researcher to suggest ways in which teachers might be better trained as consistent with the findings of Mangi, Rind & Nindwani (2023).

There were statistically significant differences between public and private school students' perspectives on mathematics, mathematics teaching methods, classroom instruction, and assessment of learned mathematical skills, according to the quantitative data collected from students. Students in public schools were rated higher than those in private schools across the board. Both male and female students and instructors had similar views.

There were notable differences in student perspectives, classroom instruction, assessment of learned mathematical practices, and mathematics teaching approaches between rural and urban schools, according to the data. In every category, pupils in urban schools scored higher than their rural school counterparts as consistent with the findings of Amirali & Halai (2021) & Khan et al (2020).

**Recommendations and Research Implications**

1. **Policy Evaluation and Implementation Research:**
   - **Recommendation:** Conduct a comprehensive evaluation of the implementation of the National Curriculum Mathematics (NCM, 2006) across different types of schools (public, private, rural, urban) to identify gaps between policy and practice.
   - **Rationale:** Understanding the extent to which schools adhere to policy guidelines and identifying barriers to implementation will help policymakers design targeted interventions to ensure uniformity and effectiveness in mathematics education.
2. **Professional Development Programs for Teachers:**
   - **Recommendation:** Investigate the impact of sustained professional development programs focused on conceptual understanding and problem-solving strategies on mathematics teachers' instructional practices.
   - **Rationale:** As the study suggests, teachers often lack awareness or commitment to innovative teaching methods. Professional development programs that are continuous and practical can bridge this gap, enhancing teachers' abilities to foster an engaging and effective learning environment.
3. **Comparative Study of Teaching Practices:**
   - **Recommendation:** Compare the teaching practices and student outcomes in mathematics between urban and rural schools, with a focus on identifying effective strategies used in higher-performing urban schools that can be adapted for rural contexts.
   - **Rationale:** The study highlights significant disparities between urban and rural schools. By understanding what works in different settings, researchers can recommend adaptable best practices to improve rural mathematics education.
4. **Student-Centered Learning Approaches:**
   - **Recommendation:** Explore the effectiveness of student-centered learning approaches, such as cooperative learning and exploratory assignments, in enhancing students' conceptual understanding and problem-solving skills in mathematics.
   - **Rationale:** The shift from rote memorization to active engagement is crucial for deep learning in mathematics. Research in this area can provide evidence-based strategies for teachers to create more interactive and thought-provoking mathematics classrooms.
5. **Assessment Techniques and Student Learning:**
   - **Recommendation:** Study the impact of formative assessment techniques on students' mathematical learning and attitudes towards the subject, comparing traditional summative assessments with ongoing, formative feedback methods.
   - **Rationale:** The study indicates that current assessment practices may not effectively measure or promote students' understanding of mathematics. Research into formative assessment can reveal how regular, constructive feedback can improve learning outcomes and student engagement with mathematics.

These recommendations aim to address the systemic issues identified in the study and promote effective teaching practices, equitable learning opportunities, and improved educational outcomes in mathematics education in Pakistan.

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