ADVANCE SOCIAL SCIENCE ARCHIVE JOURNAL
Available Online: https://assajournal.com
Vol. 03 No. 02. April-June 2025.Page#.288-296
Print ISSN: 3006-2497 Online ISSN: 3006-2500
Platform & Workflow by: Open Journal Systems

Mathematical Rigor at Primary Level in Pakistan: Teachers Problems and Prospects

Dildar Hussnain
PhD Scholar, University of Sargodha.
dildarshah136@gmail.com
Uzma Shahzadi
Director Academics, University of Sargodha.
uzmashahzadi@uos.edu.pk

Abstract
The importance of teachers in the contemporary world has assumed novel manifestations due to the advent of the modern period. The main purpose of this research study was to investigate the mathematical rigor at primary level in the district Khushab, Punjab Pakistan: Teachers Problems and Prospects. Study employed a descriptive quantitative design. The population of the study was all the mathematic teachers of grade three at public primary schools and random sampling technique was used for sample selection. The sample (210) represents 30% of the population. The self-developed Likert type questionnaire was used to collect data. A questionnaire was about students' mathematical rigor with 18 items. The value of Cronbach's alpha for students' mathematical rigor questionnaire was 0.89. The findings revealed that most of the teachers perceived that they have good level to foster student's mathematical rigor. The distribution of the data suggests that there was a greater occurrence of general in-service training among the public primary school teachers rather than the specialized subject training in mathematics.

Key words: Mathematical Rigor, Problems and Prospects, National Research Council, Primary School Teachers.

Introduction

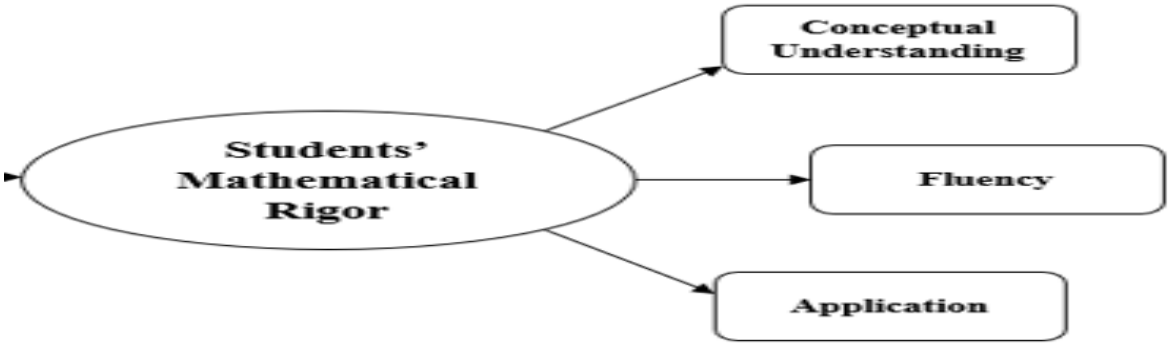
The importance of teachers in today's world has ever increased because of technological integration in classrooms. Not only are they in charge of teaching the students, but they are obligated to help them use the knowledge they have learned to enhance their abilities. If teachers are committed to continuing about a change that is truly productive, to increase the quality of education, and to grow the level of students' success, it's imperative for the recruitment of teaching faculty who do not only have the required pedagogical competencies to bring about the change and raise the educational standards. The effectiveness of any education system is dependent on the availability of teachers who have pedagogical competencies (Sulaiman & Ismail, 2020). It is a very well-known truth that a school's teachers are better at their jobs than the educational system itself; hence, a school's teachers are the primary reason why their school is successful. Students are assisted in their learning by teachers. The significance of teaching is a crucial factor in the enhancement of learning that takes place in educational settings(Smith & Gillespie, 2023).

Mathematics is known as the mother of science, and it is always an important and compulsory subject to be taught at primary level in all schools of the globe. The teacher is the most important factor that influences how well mathematics is taught in the classroom.

Successful changes in the mathematics curriculum and pedagogy can be effectively implemented by a well-prepared teacher who possess strong presentation skills and is equipped with necessary audio-visual aids (Omariba, 2022). The most important responsibility that mathematics teachers should take on is to get the next generation ready to understand and confront the effects of globalization (Bosio & Olssen, 2023).

Rigor is necessary for mathematical mastery, it cannot take the place of other components that are necessary for a successful curriculum (Guillaume, 2021). Visualize a rope with five strands that are dependent on one another and entwined with one another (Hull, Balka & Miles, 2013). This is the metaphor that researchers think might be used to illustrate the function that rigor plays in a successful mathematics course. Because students with rigor can never give up easily in problematic situations regarding learning of mathematical skills (Chamberlin & Schultz, 2021). These skills in students make them mathematically equipped and fully divergent thinkers. Pupils can participate more actively in the learning process when their teachers have strong pedagogical competencies, understand how to enhance students' mathematical rigor, and know how to boost students' mathematical creativity (Timm & Barth, 2021).

Moreover, mathematical rigor characterized by accurate reasoning, logical problem-solving, and conceptual depth is sometimes insufficiently developed in students as a result of inefficient teaching methods (Stein et al., 2009). Hussnain (2020) stated that the results with instructional technologies were worse than those of traditional instructions. This was since teachers were not trained in the use of instructional technologies for the teaching of mathematics. When it comes to the preparation of pupils for mathematical skills, government schools that have little or no access to technology encounter a variety of challenges. The lack of technology in government schools presents teachers with a variety of challenges; thus, there is a pressing need to improve teachers' pedagogical competencies so that they may successfully navigate these challenges for students' mathematical rigor and mathematical creativity in learning mathematical skills.



According to the definition that was provided by the National Research Council (2001), pupils are considered to have developed procedural fluency when they have the "calculation skills for processes flexibility, correctly, efficiently, & properly". For example, in mathematics, this indicates that students can perform operations such as adding, subtracting, multiplying, and dividing numbers precisely and with self-assurance. Students are required to show "comprehension of mathematical ideas, operations, and relations" (National Research Council, 2001). Students demonstrate a grasp of the quadratic equation in algebra by demonstrating that they know when to use it, how to solve it, how to interpret the results, and how to employ them. Students are required to demonstrate a comprehension of when to employ a specific inference

test, describe the assumptions, and show how to evaluate and use the findings in the subject of mathematics.

According to research published by the Carnegie Foundation for the Advancement of Teaching (Silva & White, 2013), students who effectively interact with their coursework demonstrate persistence in problem solving and utilize a range of efficient learning techniques. For instance, they are interested in locating useful materials, they are driven to struggle with an issue until they discover a solution to it, and they are eager to analyze their own work to spot mistakes. Students can appropriately apply their mathematics knowledge to new contexts, according to research conducted by (National Governors Association Center for Best Practices and the Council of Chief State School Officers, 2010). Algebraic applications in calculus, such as differentiating exponentials, are one example. Students can communicate effectively and express their work in a manner that is both clear and precise by using mathematical language. For mathematical rigor, students are required to show what they have done is effective, when it is effective, and why the approach they picked is acceptable. A response to the question "How do we know?" may be given by the student. Students studying calculus, for instance, should not link derivatives with the rote technique (such as dxn/dx = nxn-1), but rather with the idea of instantaneous rate of change. In a similar manner, using the statistics example from earlier, students should not identify the inference test with the computation of the t-score but rather with the notion of population, sample characteristics, and other issues that are created from the calculation (Cobb, 2018).

To be capable of teaching pupils' mathematical skills, teachers need to have specific skills in the disciplines of mathematics. In addition, teachers rely on more traditional teaching strategies to instruct students in mathematical skills. This study seeks to identify students' mathematical rigor, emphasizing the identification of effective instructional strategies that improve conceptual understanding in mathematics classrooms. Mathematical teachers often encounter considerable difficulties in improving students' comprehension of fundamental mathematical concepts. Chapman (2015) asserted that teachers need rigor to convey mathematical concepts as understandable learning experiences. May teachers' have difficulties in using tactics that foster deep mathematical understandings, resulting in students depending on rote memorization instead of achieving conceptual understanding (Jensen, 2017).

Previous studies were conducted in this area based on the national mathematical curriculum of Pakistan (Asad et al., 2020). The purpose of this research study was to investigate the mathematical rigor at primary level in the district Khushab, Punjab Pakistan: Teachers Problems and Prospects. In Pakistani primary schools, where a habitual culture of mathematics teaching is winning, this research may be beneficial for mathematics teachers to improve teachers' pedagogical competencies. Unfortunately, currently in Pakistan the students are not proficient in mathematics, majority of students failed or passed this subject with average grades (Wenr, 2020). For students to develop their mathematical abilities, it is important for teachers to have the pedagogical competences necessary to be able to provide pupils opportunities for mathematical rigor (Mrayyan, 2016). At primary school level the aim of teaching mathematical rigor is to produce such students, who have ability to cope with the real-world challenges. Hence, it is vital to examine the students' mathematical rigor at primary level in the district Khushab.

Objectives of the Study

The study had the following key objectives:

1. To examine the mathematical rigor of students at primary level.
2. To find out the problems faced by mathematics teachers at primary level.

Research Questions

1. What are the approaches to measure mathematical rigor of students at primary level?
2. What are some tentative solutions about problem faced by mathematics teachers?

Delimitations of the Study

The following delimitations were established throughout the study's execution:

- Only grade three students of public primary schools.
- The only mathematic teachers in the district of Khushab's public primary schools.

Research Methodology

Descriptive quantitative research design was employed to find out the perception of mathematics teachers. The study's population consisted of all (692) grade three mathematics teachers employed by public primary schools of Khushab. After defining the target population, the sample size for the survey was calculated. The sample was selected using the random sampling technique. There was a total sample of 210 mathematics teachers. To measure student's mathematical rigor of grade three students a questionnaire was also used to collect data from mathematics teachers.

Table 1.1 Reliability of Students' Mathematical Rigor Tool (SMR)

Reliability Statistics	
Cronbach's Alpha	No. of items
0.89	18

The reliability data in table 1.1 indicated that the Cronbach alpha (0.89) for the students' mathematical rigor questionnaire administered to mathematics teachers was considered highly reliabe.

Table 1.2 Factor wise Reliability Statistics of Students Mathematical Rigor Tool (SMR)

Factors of SMR Tool	**Cronbach's Alpha**	**No of Items**
Conceptual Understanding	.84	07
Fluency	.81	07
Application	.75	04

Table 1.2 represented the reliability statistics of the Students' Mathematical Rigor (SMR) questionnaire indicated a consistent level of internal reliability across all factors. The reliability of Conceptual Understanding, Fluency, and Application were high, as shown by Cronbach's alpha values, which range from 0.75 to 0.84. The coefficients indicated that the items within each component consistently measured the desired construct, demonstrating reliability in measuring students' mathematical rigor.

Primary School Teachers' Perception of Students' Mathematical Rigor

Table1.3 Teachers Perceptions regarding "Conceptual Understanding" on Students' Mathematical Rigor

Sr.No	**Statement**	**Never%**	**Rarely%**	**Sometime%**	**Often%**	**Always%**	**SD**	**Mean**
1	Students take an interest in learning mathematical concepts.	0.6	1.8	20.1	35.4	41.9	0.85	4.16

2	Students can explain concepts about number operations	0	1.7	20.6	34.2	43.3	0.81	4.19
3	Students can recognize fractions.	1.2	4.5	17.9	32.7	43.6	0.93	4.13
4	My students feel confident in teaching concepts like measurement, length, and mass	0.6	5.3	17.6	34.9	41.3	0.92	4.11
5	Students show interest in PSQ.	1.0	6.2	15.8	38.4	38.4	0.93	4.07
6	Students enjoy working in groups to enhance their CU	2.0	2.2	18.7	35.7	41.1	0.92	4.12
7	Students use alternative solutions for difficult concepts.	3.9	6.6	19.2	33.2	36.9	1.08	3.93
	Overall	**1.32**	**4.04**	**18.55**	**3.5**	**40.92**	**0.91**	**4.10**

The results obtained from table 1.3 which indicated that teachers' perception about this aspect had a mean value of (Mean=4.10, SD=0.91). Statistical analysis of given statements evaluated the degree of enthusiasm that pupils have towards acquiring knowledge about mathematical concepts. The results revealed that 40.92% of participants hold the belief that pupils always demonstrate curiosity. While 1.32% participants were of the view that participants hold the belief that students had no conceptual understanding about rigor.

Table 1.4 Teachers Perceptions about "Fluency" on Students' Mathematical Rigor

Sr.No	Statement	Never %	Rarely%	Sometime %	Often%	Always%	SD	Mean
8	Students can fluently perform basic mathematical operations such as ASMD	0.4	1.3	16.7	34.8	46.6	0.80	4.26
9	Students' MF in number operations and fractions is at the optimal level.	0	1.2	14.0	46.8	37.8	0.72	4.21
10	Students accurately apply mathematical PSM	0	3.7	15.9	41.2	39.1	0.82	4.16
11	Students accurately communicate measurement solutions in class.	1.4	4.5	21.9	34.8	37.3	0.94	4.02
12	Students are efficient in mathematical data handling skill.	2.2	4.4	20.7	35.3	37.3	0.97	4.01
13	Students are efficient in using appropriate MCR	1.3	5.0	18.3	34.9	40.3	0.94	4.08
14	Students listen to my suggestions for improving MF	0	1.2	7.5	36.1	55.1	0.68	4.45
	Overall	**0.75**	**3.04**	**16.44**	**37.7**	**41.92**	**0.84**	**4.17**

The results derived from the analysis of table 1.4 show that teachers' perspectives on that topic show an average value of (Mean=4.17, SD= 0.84). The data indicated that 41.92% of the

participants hold the belief that pupils always demonstrate fluency. While 0.75% participants indicated that the respondents were never questioned on the proficiency of pupils in mathematical calculations, including both whole numbers and fractions.

Table 1.5 Teachers Perceptions regarding "Application" on Students' Mathematical Rigor

Sr.No	Statement	Never%	Rarely%	Sometime%	Often%	Always%	SD	Mean
15	Students can apply learned mathematical knowledge to solve questions.	0.4	3.5	11.7	32.2	52.1	0.84	4.32
16	Students can apply mathematical knowledge to solve daily life problems	0.9	2.4	11.1	34.9	50.4	0.83	4.32
17	Students explain strategies to apply MK	1.8	5.2	15.7	35.5	41.7	0.96	4.10
18	Students can apply mathematics knowledge appropriately to new contexts.	5.7	7.5	11.8	33.0	41.9	1.16	3.98
	Overall	**2.2**	**4.65**	**12.57**	**33.65**	**46.52**	**0.95**	**4.18**

The results obtained from table 1.5 shows teachers' perceptions about students' mathematical rigor related to mathematical application, indicated that teachers' views about this aspect have a mean value of (Mean=4.18, SD= 0.95). The data indicated that 46.52% of the participants feel that students always apply their knowledge. On the other hand, 2.2% participant were of the view that never belief that students always use their knowledge effectively.

Findings

The following findings were drawn from the teachers' perception of students' mathematical rigor:

1. The mean score (Mean= 4.10, SD=0.91) reflected uniform evaluations of students' conceptual understanding. Approximately 40.92% of teachers consistently acknowledged a high level (always) of student involvement, attention, and proficiency in mathematical concepts, indicating the efficacy of instructional strategies in promoting conceptual understanding related to students' mathematical rigor.
2. The results indicated an overall mean score (Mean=4.17, SD=0.84), reflecting strong perceptions of students' fluency in mathematical rigor. Teachers consistently (41.92%) assessed students as always demonstrating proficiency across all dimensions, with the greatest marks noted in students' receptiveness to concepts and their capability to execute basic mathematical operations. The findings emphasized the need to cultivate fluency in both fundamental and advanced mathematical skills to improve overall students' mathematical rigor performance.
3. Most teachers (46.52%) perceived students as always proficient in using mathematical knowledge to resolve mathematical problems, with an overall mean score (Mean=4.18, SD=0.95). This indicated that pupils have shown competence in applying theoretical knowledge to practical problem-solving.

These findings indicated that the students had a solid understanding of fundamental mathematical concepts. The measure of fluency, which is an important component of

mathematical competency, had an average score of (Mean=4.17) and a standard deviation of (SD=0.84). The high average score, along with a somewhat high standard deviation, suggests that most students had a strong aptitude in mathematical operations. However, there were considerable variations in skill levels across individuals. Lastly, the application indicator, which measures the ability to use mathematical ideas in real-life situations, had a mean score of (Mean=4.18) and a standard deviation of (SD=0.95). This suggests that there was a high degree of application abilities. In short, the results indicated that students possess a noteworthy degree of mathematical rigor, which were shown by their solid conceptual understanding of mathematical ideas, high level of fluency, and fluent application of these concepts. However, the range of differences identified in fluency and application scores highlights the need for ongoing endeavours to guarantee uniformity and thoroughness in mathematical skills across various situations.

Conclusion

Evaluating the mathematical rigor in primary education requires thoughtful examination of teaching techniques, evaluation approaches, and the cognitive challenges presented to students. By integrating problem-solving activities, performance assessments, extended answer questions, rubrics, and realistic assignments into their teaching and assessment techniques, teachers may accurately gauge and enhance mathematical rigor among primary school students. These techniques not only provide useful insights on students' cognitive processes and logical abilities in mathematics but also enhance the training of critical thinking skills and a more profound comprehension of mathematical subjects. Furthermore, by promoting a culture of mathematical rigor in primary schools, teachers may provide a solid groundwork for students' future achievements in mathematics and other areas.

Discussion of the study

This study examined the mathematical rigor at primary level in the district Khushab, Punjab Pakistan: Teachers Problems and Prospects.The results indicated that well trained teachers, who employ diverse instructional techniques, play a crucial role in enhancing students' ability to engage with mathematical concepts at both a procedural and conceptual level. Mathematical rigor involved precision, logical structuring and deep understanding, which are best cultivated thorough high quality pedagogical competencies. Research by (Hunter & Crespo, 2019) indicated that structured and conceptually rich mathematics instructions foster deep learning, enhancing students' abilities to engage critically with mathematical concepts. The study also corroborates previous research on the significant of professional development for teachers. According to Darling-Hammond (2020), continuous professional development programs focusing on pedagogical enhancement result in improved student learning outcomes, particularly in mathematics. Similarly, Lynch, Chin and Blazar (2017) emphasizes that mathematics instructions that fosters rigor require teachers to employ a mix of structured problem-solving approaches and exploratory learning opportunities. This study's findings reinforce these perspectives, suggesting that professional training for mathematics teachers should integrate strategies that balance mathematical rigor in teaching instructions. In conclusion, the findings align with existing literature that emphasizes the importance of effective instructional strategies in shaping students' mathematical capabilities. By employing structured and inquiry-based teaching methods, teachers can enhance both the analytical and creative aspects of students' mathematical learning, ultimately contributing to their overall mathematical proficiency.

Recommendations

1. Allocation of resources by policy and planning organizations should be directed towards the development of comprehensive teacher training programs that aim to enhance pedagogical abilities.
2. Collaboration between teacher education institutions and curriculum makers is necessary to include activities and projects. This might include creating open-ended problem-solving assignments, integrating real-world applications of mathematical principles, and fostering student-led inquiry and investigation.
3. Policy and planning organizations should help with continuous professional development opportunities for teachers to improve their teaching skills and practices that develop students mathematical rigor.
4. These may include workshops, seminars, and conferences that specifically address efficient teaching tactics, assessment methodologies, and classroom management procedures.
5. Teacher education institutions should actively encourage interdisciplinary cooperation between educators, mathematicians, psychologists, and other stakeholders to investigate and develop creative methods for teaching and learning mathematics.
6. Policy and planning agencies, as well as teacher education institutions, may have a significant impact on promoting innovation in mathematics instruction by adopting these ideas. Consequently, this may enable students to develop the ability to analyze and evaluate information, find solutions to complex problems, and continue learning throughout their lives, equipping them to succeed in the fast-paced and constantly evolving 21st-century society.

References

Bosio, E. and M. Olssen (2023). "Critical global citizenship: Foucault as a complexity thinker, social justice and the challenges of higher education in the era of neo-liberal globalization–A conversation with Mark Olssen." Citizenship Teaching & Learning **18**(2).

Chamberlin, S. A. and C. B. Schultz (2021). Secondary mathematics for high–ability students. The handbook of secondary gifted education, Routledge**:** 417-438.

Chapman, O. (2015). Mathematics teachers' knowledge for teaching problem solving. *LUMAT: International Journal on Math, Science and Technology Education*, *3*(1), 19-36.

Civil, M., Hunter, R. O. B. E. R. T. A., & Crespo, S. (2019). Mathematics teachers committed to equity. *International handbook of mathematics teacher education: Knowledge, beliefs, and identity in mathematics teaching and teaching development*, *1*, 243-274.

Cobb, K. H. (2018). A Study of Rigor, Teacher Self-Efficacy, and Student Achievement in Three High Schools in a Rural School District in Eastern North Carolina, Gardner-Webb University.

Darling-Hammond, L. (2020). Accountability in teacher education. *Action in teacher Education*, *42*(1), 60-71.

Guillaume, N. M. (2021). Instructional Strategies and Rigor: Private School Administrator and Teacher Perspectives on Improving Minnesota's College Mathematic Readiness, Winona State University.

Hull, T. H., Balka, D. S., & Harbin Miles, R. (2013a). Defining mathematical rigor [Pamphlet]. Pflugerville, TX: Leadership Coaching Mathematics (LCM).

Jensen, J. L. (2017). *Teachers' use of reasoning-based questions in procedural and conceptual lessons*. The University of Iowa.

Lynch, K., Chin, M., & Blazar, D. (2017). Relationships between observations of elementary mathematics instruction and student achievement: Exploring variability across districts. *American Journal of Education*, *123*(4), 615-646.

Mrayyan, S. (2016). Investigating Mathematics Teacher's Role to Improve Students' Creative Thinking. *American Journal of Educational Research*, *4*(1), 82-90.

Mughal, S. H., Asad, M. M., & Adams, D. (2020). Goals of the national mathematics curriculum of Pakistan: educators' perceptions and challenges toward achievement. *International Journal of Educational Management*, *35*(1), 159-172.

Silva, E. and T. White (2013). "Pathways to Improvement: Using Psychological Strategies to Help College Students Master Developmental Math." Carnegie Foundation for the Advancement of Teaching.

Smith, C. and M. Gillespie (2023). Research on professional development and teacher change: Implications for adult basic education. Review of Adult Learning and Literacy, Volume 7, Routledge**:** 205-244.

Stein, M. K., Smith, M. S., Henningsen, M. A., & Silver, E. A. (2009). **Implementing standards-based mathematics instruction: A casebook for professional development.** Teachers College Press.

Sulaiman, J. and S. N. Ismail (2020). "Teacher competence and 21st century skills in transformation schools 2025 (TS25)." Universal Journal of Educational Research **8**(8): 3536-3544.

Timm, J. M., & Barth, M. (2021). Making education for sustainable development happen in elementary schools: The role of teachers. *Environmental Education Research*, *27*(1), 50-66.

Omariba, A. (2022). The Role of Integrating Audio-Visual Media to Teaching and Learning in Public Primary Teacher Training Colleges in Kenya.