



Investigating the Impact of Continuous Professional Development on Content Knowledge in Mathematics at the Elementary Level

Mumtaz Begum^a, Dr Muhammad Idris^b, Dr Samreen Mehmood^c, Azmat Ali Shah^d

^aMPhil Scholar, Department of Education, Abdul Wali Khan University Mardan. ^bAssociate Professor, Department of Education, Abdul Wali Khan University Mardan. ^cAssistant Professor, Department of Education, Abdul Wali Khan University Mardan. ^dLecturer, Department of Education, Abdul Wali Khan University Mardan.

*Email: mbehrozkhani05@gmail.com

Abstract: This study examines the impact of Continuous professional development on elementary mathematics teachers content knowledge and its subsequent impact on students. A mix method approach is employed in this research, about 200 elementary teachers were surveyed. Professional development is the new norm that has completely changed the working dynamics of an institution. It is being called the new norm where in simple words it can be explained as the in-work development of new skills or relative adoptions to enhance ones working in a system. The objectives of this study were to investigate teachers' content knowledge of mathematics in the context of continuous professional development. The second objective was to investigate the challenges teachers faced in the content knowledge of mathematics. Elementary female teachers of Tehsil Katlang District Mardan were the study participants. The sample size was 200. Data was collected through questionnaires. The research questions pertained to the objectives and was analyzed by SPSS V22.

Key words: CPD, Teachers, Content knowledge.

1. Introduction

For instructors, ongoing professional development has several benefits, including raising academic performance, expanding research skills, and refining instructional strategies. It aids educators in establishing a productive and welcoming learning environment for pupils. To improve teachers' classroom practices, the ongoing professional development process encompasses certification and subsequent activities for every member of school staff. The goal is to improve the caliber of the instructional process (DSD, 2007b). Teachers who get ongoing professional development are encouraged to innovate, which boosts their drive and self-assurance to do their jobs well. Teachers learn about cutting-edge technology and instructional methods and how to use them in the classroom. To obtain intended results, it is crucial to uphold specified standards. Teachers who are encouraged to think critically are better able to spot knowledge gaps and improve their work. Additionally, it fosters scientific thinking, inspiring instructors to thrive in their existing positions and take on new duties. Continuous professional development assists teachers in their career growth and offers chances for career advancement (Purdon, 2003).

Mathematics content knowledge is grouped into two different types where one is common mathematics content knowledge and the other is specialized content knowledge. Common content knowledge of mathematics is described as the knowledge that is required for solving a mathematics problem by a person. The motive behind calling this common content knowledge is that this knowledge is not specific to teaching and the ordinary or in other words non-teachers are likely to know it and can interpret and use it. Examples may include simple word

problems. Specialized content knowledge is the knowledge unique to the teachers and is needed to teach productively. For example, a teacher is required to learn how a simple algebra equation solves and the mechanics behind solving it. The Directorate of Staff Development is one of the organizations in Pakistan that is in charge of giving instructors chances for CPD. For the past 50 years, the Directorate of Staff Development (DSD) has remained fully engaged in the preparation of educators. Producing knowledgeable, devoted, and inspired staff members for both teaching and non-teaching roles is its primary goal. With relation to the pay scale, preparation, and certification requirements for teachers, the DSD advises the Punjab Public Policy. It coordinates activities for Punjabi public school teachers' professional development and makes sure that there are high-quality pre-service institutes available. The DSD also emphasizes strengthening the capabilities of relevant organizations and the district administration. It develops skilled instructors who are in charge of managing training initiatives. Pre-service and professional development for primary educators, kindergarten teachers, IT and science instructors, in addition to education for heads, EDOs, DEOs, AEOs, and DDOs, are all included in these programs. The DSD is additionally in charge of administering the standard of ethics for instructional procedures and amending the academic calendar.

It is important to survey and explore educator's perceptions about how a subject is taught whether be it Mathematics or Science are taught (El-Deghaidy & Mansour, 2015). The goal of continuous professional development (CPD), which starts after initial training, is to make people lifelong learners. It is given on the job and steadily increases people's knowledge, skill, and competence all over the course of their careers, which boosts job satisfaction. CPD is designed to meet the demands of the workforce, companies, and society as a whole. It entails both solitary and group activities to improve the standard of learning.

1.1 Statement of the Problem

The need to evaluate the effect of Continuous Professional Development (CPD) programs on the mathematics subject knowledge of primary school teachers in district Mardan is the issue this study attempts to address. In order to finally increase the standard of mathematics teaching in district Mardan, it is necessary to examine and assess the success rate of CPD programs in strengthening the mathematical topic expertise of primary school teachers.

1.2 Significance of the Study

The study's findings hold substantial practical implications, potentially assisting primary teachers in enhancing their subject knowledge and pedagogical skills to elevate teaching and learning standards. Consequently, policymakers are encouraged to initiate new professional development initiatives tailored to primary educators, prioritizing the provision of the knowledge and skills required to deliver exceptional academic outcomes for students. This study underscored the significance of government agencies enhancing the academic capabilities of elementary teachers to align with international standards and approaches, enabling them to advance in their careers.

1.3 Objectives

- a) To evaluate math teachers' expertise, knowledge, and competencies within the context of ongoing professional development.
- b) To determine which subject areas in mathematics presented challenges for teachers.

1.4 Research Questions

- a) How does continuing professional development affect educators' knowledge, understanding, and skills?
- b) In what areas did maths teachers encounter challenges

2. Literature Review

Professional development is an important aspect of almost every new scheme or education policy (Anwar, 2014). Continuous skill improvement or education while working that will result in greater learning, a working environment, and professional progress may be summed up as professional development. In many ways, teacher preparation is important because it equips educators to carry out a variety of roles, including developing students' potential, functioning as mentors, advancing social and educational change, and promoting self-assurance and creativity. Ainscow (2004) emphasizes the significance of taking into account contextual issues in teacher development, much as effective classrooms establish environments that encourage the learning of all students. With the purpose of spreading research results on successful teaching and schools and in response to the desire for

enhancing student accomplishment, in-service education has gained prominence in comparison to initial training for new educators (Dearden, n.d.).

Continuous professional growth is a crucial and pressing problem since it affects students' futures and Pakistan's overall development. Building effective citizens requires a solid foundation in education. By including monitoring, follow-up services, mentorship, accountability, rewards, and in-class assistance for instructors, the new CPD model fills up prior gaps. The Punjabi government has invested a substantial sum of money in this initiative. This study aims to assess the efficacy of the framework for continuous professional development by shedding light on a number of elements, including ongoing evaluation, professional development, and the function of career growth moments, which have not been thoroughly covered in prior research (DSD, 2007a). The goal of continuous professional development (CPD) in Pakistan is to raise the standard of the teaching and learning environment. This is accomplished through instructors' topic expertise, instructional abilities, and encouraging classroom dispositions. Improvements in professional competence, educational quality, motivation, and teacher responsibility are among the CPD goals in Pakistan (DSD, 2007a). According to McCray and Chen (2011), in order to guarantee that early mathematics receives the proper focus, it is crucial to match early mathematics training with ideas about developmentally appropriate instruction. They contend that early childhood educators may think that math instruction imposes a rigid curriculum that is unsuitable for these environments. The notion to teach maths in a child-initiated, culturally appropriate manner might be supported by seeing mathematics as a procedure instead of a set of rules. Additionally, early childhood educators frequently reduce mathematics to numbers and operations while neglecting crucial mathematical skills like reasoning, problem-solving, and links to the real world of young children (Copley, 2004). Early childhood instructors must have a thorough grasp of mathematics that is pertinent to young children's education and beyond it, as well as the capacity to spot mathematics in commonplace settings, because natural learning scenarios are frequently unexpected. In order to determine a child's degree of learning in a certain setting, teachers also need to understand how mathematical abilities grow. The most crucial requirement of all is that early childhood instructors have the knowledge and abilities to design environments that enhance children's acquisition of mathematics (Anders & Rossbach, 2015; Gasteiger, 2012). The conventional professional growth events for teachers, such as seminars, expert lectures, instructional seminars, and research conferences, get major funding from governments all over the world (Gersten et al., 2010)

3. Methodology

This study is descriptive and quantitative. It involves collecting pre and pro assessment of elementary school teachers of mathematics. Statistical analysis has been done for this study by using SPSS for the analysis of data. This analysis determines the statistical significance of content changes in teachers' knowledge. Also co-relation analysis and descriptive analysis are conducted to discover relationships and patterns in data.

3.1 Concerned Population

The concerned population for this study were all female primary, elementary school teachers of public sector schools in Tehsil Katlang of district Mardan.

3.2 Sampling

The sample size was 200 for this study and the technique for the collection of the sample size was a convenience method. There are 97 government primary schools for girls in tehsil Katlang and 480 female teachers provided their services in these schools

3.3 Research Tool

The research study is quantitative and a self-administered questionnaire was given to the participants as a data collection tool to collect the data. The questionnaire was based on a Likert scale.

4. Statistical Analysis

The questionnaires were analyzed in terms of descriptive and inferential statistics by using SPSS V22.0 and the referencing has been done through Endnote 20.

Table 1: Frequency

STATEMENTS	Strongly agree		agree		undecided		disagree		strongly disagree	Mean	ST. D
	f	%	f		f	%	f	%	%		
The content of CPD helps me to improve my mathematics subject knowledge	12	6	185		1	0.5	2	1	0	4.035	3.51425
CPD focuses on math's content improve elementary teacher's knowledge and instruction and ultimately their student's achievements	9	4.5	187		2	1	2	1	0	4.015	3.49285
CPD developing our mathematics knowledge of concepts in a variety of ways to depend our understanding	13	6.5	183		2	1	2	1	0	4.035	3.515679
CPD focus on the main features of the textbook of mathematics based on curriculum 2020.	18	9	169		2	1	1	0.5	0	3.87	3.465545
CPD opportunities to relate the concept of mathematics with daily life example.	14	7	183		1	0.5	2	1	0	4.045	3.525621
In CPD I have learned different strategies to teach whole number options (Add, Subtraction, Multiplication and division) and solve fraction	15	7.5	174		3	1.5	8	4	0	3.98	3.479943
CPD enhance my logical thinking and reasoning in mathematics	16	8	176		4	2	3	1.5	0.5	4.015	3.508561
In CPD I have learned questioning and drawing techniques for teaching of geometry with the help of object and figures.	11	5.5	169		10	5	10	5	0	3.905	3.411744

Interpretation of table 1

"The content of CPD helps me improve my mathematics subject knowledge."

- 6% of respondents strongly agreed, and 92.5% agreed.
- 0.5% was undecided, 1% disagreed, and no respondents strongly disagreed.
- The mean score is 4.035, indicating that the majority of respondents found the CPD content helpful in improving their mathematics subject knowledge.

"CPD focuses on math's content to improve elementary teachers' knowledge and instruction, and ultimately their students' achievements."

- 4.5% of respondents strongly agreed, and 93.5% agreed.
- 1% was undecided, 1% disagreed, and no respondents strongly disagreed.
- The mean score is 4.015, suggesting that respondents perceived CPD as focusing on math's content and benefiting elementary teachers' knowledge and instruction, leading to improved student achievements.

"CPD develops our mathematics knowledge of concepts in a variety of ways to deepen our understanding."

- 6.5% of respondents strongly agreed, and 91.5% agreed.
- 1% was undecided, 1% disagreed, and no respondents strongly disagreed.
- The mean score is 4.035, indicating that CPD was perceived as developing mathematics knowledge through diverse approaches to enhance understanding.

"CPD focuses on the main features of the textbook of mathematics based on the curriculum 2020."

- 9% of respondents strongly agreed, and 84.5% agreed.
- 1% was undecided, 0.5% disagreed, and no respondents strongly disagreed.
- The mean score is 3.87, suggesting that CPD was perceived as focusing on the main features of the mathematics textbook aligned with the curriculum.

"CPD provides opportunities to relate the concept of mathematics with daily life examples."

- 7% of respondents strongly agreed, and 91.5% agreed.
- 0.5% was undecided, 1% disagreed, and no respondents strongly disagreed.
- The mean score is 4.045, indicating that CPD was perceived as offering opportunities to connect mathematical concepts with real-life examples.

"In CPD, I have learned different strategies to teach whole number operations (Addition, Subtraction, Multiplication, and Division) and solve fractions."

- 7.5% of respondents strongly agreed, and 87% agreed.
- 1.5% was undecided, 4% disagreed, and no respondents strongly disagreed.
- The mean score is 3.98, suggesting that CPD was perceived as providing valuable strategies for teaching whole number operations and fraction problem-solving.

"CPD enhances my logical thinking and reasoning in mathematics."

- 8% of respondents strongly agreed, and 88% agreed.
- 2% were undecided, 1.5% disagreed, and 0.5% strongly disagreed.
- The mean score is 4.015, indicating that CPD was perceived as enhancing logical thinking and reasoning skills in mathematics.

"In CPD, I have learned questioning and drawing techniques for teaching geometry with the help of objects and figures."

- 5.5% of respondents strongly agreed, and 84.5% agreed.
- 5% were undecided, 5% disagreed, and no respondents strongly disagreed.
- The mean score is 3.905, suggesting that CPD provided learning opportunities for questioning and drawing techniques in geometry teaching.

Table 2: Frequency

STATEMENTS	Strongly agree		agree		undecided		disagree		Strongly disagree		mean	ST. D
	f	%	f	%	f	%	f	%	f	%		
At primary level the syllabus of mathematics is sufficient.	25	12.5	150	75	10	5	10	5	5	2.5	3.9	3.449638
Technological equipment in the school is available for teaching mathematics.	3	1.5	18	9	4	2	160	80	15	7.5	2.17	1.760682
I teach mathematics with professional confidence and a warm heart.	10	50	98	49	2	1	0	0	0	0	4.49	3.992493
I believe that mathematics is exciting and interesting to teach.	117	58.5	83	41.5	0	0	0	0	0	0	4.585	4.084116
I believe that I get never tired of teaching mathematics.	97	48.5	96	48	6	3	3	1.5	4	2	4.485	3.958535
In my opinion mathematics is a boring subject.	5	2.5	4	2	5	2.5	95	47.5	9	45	1.685	1.356466

Interpretation of table 2

"At the primary level, the syllabus of mathematics is sufficient."

- 12.5% of respondents strongly agreed, and 75% agreed with this statement.
- 5% were undecided, 5% disagreed, and 2.5% strongly disagreed.
- The mean score is 3.9, indicating a moderately positive perception overall.

"Technological equipment in the school is available for teaching mathematics."

- Only 1.5% of respondents strongly agreed, while 9% agreed.
- 2% were undecided, 80% disagreed, and 7.5% strongly disagreed.
- The mean score is 2.17, suggesting a relatively negative perception regarding the availability of technological equipment for teaching mathematics.

"I teach mathematics with professional confidence and a warm heart."

- Half of the respondents strongly agreed, and 49% agreed.
- 1% were undecided, and no respondents disagreed or strongly disagreed.
- The mean score is 4.49, indicating a high level of confidence and positive attitude among the respondents.

"I believe that mathematics is exciting and interesting to teach."

- 58.5% of respondents strongly agreed, and 41.5% agreed.
- No respondents were undecided, disagreed, or strongly disagreed.
- The mean score is 4.585, suggesting that the majority find mathematics exciting and interesting to teach.

"I believe that I never get tired of teaching mathematics."

- 48.5% of respondents strongly agreed, and 48% agreed.
- 3% disagreed, 1.5% strongly disagreed, and 2% were undecided.

- The mean score is 4.485, indicating a generally positive attitude towards teaching mathematics without getting tired.

"In my opinion, mathematics is a boring subject."

- Only 2.5% of respondents strongly agreed, and 2% agreed.
- 2.5% were undecided, 47.5% disagreed, and 45.5% strongly disagreed.
- The mean score is 1.685, suggesting a predominantly negative opinion regarding mathematics being a boring subject.

5. Conclusion

Pure mathematics and mathematics education have a dynamic relationship, but they also differ in certain ways. The question of whether having a thorough grasp of math itself is sufficient to properly teach the subject is one that is frequently brought up in the profession. It is crucial to close the gap among pure math and math instruction in order to answer this question. The results of this study show that, although a thorough understanding of mathematics is required, it is not enough to effectively teach mathematics. Additionally, having a strong foundation in pedagogical topic knowledge is essential while teaching mathematics. Therefore, during their university studies, math instructors should obtain a thorough education that includes both mathematical expertise and pedagogical content knowledge.

5.1 Recommendations

The following suggestions are put out in light of the findings:

- a. In order to improve and equalize the efficacy of rural teachers in comparison to their urban counterparts, rigorous surveillance of the CPD program is required, particularly in rural regions.
- b. Without regard to gender, continuous professional development (CPD) should be made mandatory for all teachers in primary through upper secondary schools.
- c. It is advised that this initiative be extended to other parts of Pakistan.
- d. Analogous studies should be carried out in the other regions of Khyber Pakhtunkhwa, Pakistan, to evaluate the program's effects on the professional growth of educators (both male and female).
- e. Seminars, conferences, and other types of events should be held at the elementary school level to help university professors share their expertise.
- f. To give elementary teachers current pedagogical expertise, in-service training should be given at the university level.

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