



IMPACT OF PROFESSIONAL DEVELOPMENT ON SELF EFFICACY OF MATHEMATICS TEACHERS

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ABSTRACT

This study aimed to know that Professional development play a crucial role in improving the self-efficacy and problem-solving skills of mathematics teachers at the secondary level. By providing teachers with new knowledge, skills, and opportunities to apply these in real-world settings, they can become more confident and effective in their teaching of mathematics. The objectives of the study were to assess the perceptions of mathematics teachers about their professional development in mathematics and to investigate the impact of professional development on self-efficacy and problem-solving skills of mathematics teachers. The population of the study was contained the all teachers of three districts in Hazara division. The reliability of the scale is determined through Cronbach's Alpha and all the statements were found reliable. Data were collected, scored, tabulated and analyzed by using percentage, mean, standard deviation and person correlation and regression as tests of statistical. Education policymakers may consider the findings of this study when designing and implementing professional development programs for teachers to ensure that they are having the desired impact on teachers' skills and competencies. Recognition of the role of other factors: The study suggests that while professional development may have some impact on teachers' skills, other factors such as prior experience and education may play a larger role.

Keywords: reliability, education, competencies, mathematics

BACKGROUND:

It is universally acknowledged that teachers are the key pillars behind the success of any education system, the quality of education and its delivery to the main stakeholders; students. However, this role can be performed efficiently if they can instill and maintain a high level of competence, character, communication, self-control, self-discipline and resourcefulness. In modern systems, the role of schools is changing and the same goes for teachers. They are expected to teach in more diverse classrooms, put more attention on including students with special needs in their classes, use information and communication technology more effectively, and spend more time preparing within evaluative and accountability frameworks (Isoré, 2009). But in the Pakistani education system, teachers are still far behind the international and even local required standards, especially in Government schools (Ahmad, Gul, & Kashif, 2022; Amir et al., 2020; Gul & Khilji, 2023; Khan & Kirmani, 2003; Salameh et al., 2022). While teachers endeavor to find new methods to interact with their students via technology, we must pay close attention to what we are teaching to our students (Gul et al., 2020). They are still using conventional methods and do not upgrade and enrich themselves with such techniques which are required for the modern education system. Consequently, their students do not have adequate,



advanced and theoretical knowledge which is assumed the basic assumption behind the new curricula of mathematics in Pakistan.

Teachers have typically received pre-service, in-service, and career-long professional development through seminars, training, conferences and workshops. According to the traditional interpretation of this concept, the school division hires specialists and consultants from outside the field of specialization to give in-service pre-service workshops and seminars to teachers at the secondary school level. The process of professional development of teachers is practiced in all over the world, especially in developed countries. Like, in the participating nations, 89% on average of lower secondary school teachers participated in professional development. The administration has serious concerns over the 11% who did not receive any training (Isoré, 2009). Literature has explained that professional development can be accelerated through teachers' professional activities which are further augmented through regular self-assessment. This assessment would help the teachers in developing problem-solving skills and create a significant difference in the faculty (Sharma & Pandher, 2018). Research has revealed that if teachers become better acquainted with technology (computers, internet, and media tools), they are more ready to teach online (Batool et al., 2022; Gul et al., 2022).

Development is a complex process and has horizontal and vertical dimensions. Professionals concentrate on honing a specific skill on the horizontal dimension. We contend that this equates to learning that is focused on information and skills and is not considered transformative learning. Professionals who grow vertically concentrate on developing transformative learning skills and deepening their knowledge of the practice. Professional development can occur in both vertical and horizontal directions for some people (Ahmad & Gul, 2021; Gul, Ayub, et al., 2021; Gul, Muhammad, et al., 2021) (Noben et al., 2021). One could counter that the individuals who appear to be stationary are making development in their teaching abilities but not in their comprehension of teaching. This is consistent with other research that found some teachers priorities broadening their teaching repertoire while exhibiting little interest in reflecting activities, which are essential for transformative learning (Ahmad, Gul, & Zeb, 2022; Gul et al., 2022; Gul, Ayub, et al., 2021; Nevgi & Löfström, 2015).

Mathematics is sometimes referred to as the science of numbers, quantities, and forms, as well as their relationships. Mathematics, like all other branches of science, is always changing. As technology advances, so are the tools accessible to instructors for enhancing the teaching-learning process. Mathematics instructors, as practitioners, must stay current on any advancement that are relevant to their students. As a result, there is an increased demand for establishing and encouraging professional development among mathematics instructors (Lee *et al.*, 2018).

Professional development refers to in-service training to improve trainees' knowledge base and abilities. Professional development in the context of teachers promotes in-service training where instructors may improve their topic knowledge and pedagogical abilities. It is usually given in a formal environment; however it may also be given informally at times. Its primary goal is to improve the total effectiveness of the teaching-learning process by strengthening the potentials of the instructors and, eventually, the performance of the learners. Professional development is primarily training given to teachers throughout their service tenure to help them improve their capabilities in many areas of subject and pedagogy. It is critical to encourage a cycle of continual professional improvement for teachers in order to secure learners' bright futures (Biasuttiet *al.*, 2019).

Mathematics instructors are constantly challenged to make the topic interesting and attractive to their students at the secondary and senior secondary levels. As mathematics becomes more complicated, mathematics teachers find it more challenging to keep students interested in the subject. It is an important step for students since it prepares them for further education as well as their eventual career. It is critical that mathematics instructors participate in professional development programs on a regular basis in order to reinforce the educational delivery methods they use,



particularly at the secondary and senior secondary levels (McPhail, 2018). Self-efficacy is an essential concept in the teaching profession because it influences a teacher's capacity to create and accomplish objectives, deal with stress, and adapt to change. Teachers who have a strong sense of self-efficacy are more likely to set ambitious objectives for themselves and their students, persist in the face of adversity, and recover swiftly from failures. They also enjoy better mental and physical health and experience less anxiety and despair. Self-efficacy is linked to a variety of teaching outcomes, including student success, classroom management, and instructional techniques. Teachers who have a strong sense of self-efficacy have more favorable attitudes toward their students, set greater expectations for their students, and use more successful teaching practices (Bukhari et al., 2021; Gul & Khilji, 2021; Gul, Tahir, et al., 2021).

Self-efficacy may be created and improved through providing teachers with professional development opportunities, offering feedback on their teaching, and allowing them to engage with their colleagues. Professional development opportunities aimed at increasing teacher self-efficacy, such as goal-setting and problem-solving training, have been shown to improve a variety of teaching outcomes (Gul, Tahir, et al., 2020; Gul, Zakir, et al., 2021; Said et al., 2021).

Self-efficacy is a critical psychological concept in the teaching profession because it influences a teacher's capacity to create and accomplish objectives, deal with stress, and adapt to change. According to research, teacher self-efficacy is positively associated to a variety of teaching outcomes, including student success, classroom management, and instructional methods. As a result, it is critical for school administrators and policymakers to recognize the importance of teacher self-efficacy and to take steps to improve it through professional development opportunities, emotional and physiological support, verbal persuasion, and opportunities for teachers to collaborate and observe their peers (Aydn & Kurt, 2022)

Self-efficacy, or confidence in one's own talents, is a vital characteristic for mathematics instructors to have. This self-belief may result in a positive attitude toward the topic and a desire to take on obstacles, which can lead to improved student performance. A strong feeling of self-efficacy may also assist a teacher in managing stress and maintaining control in the classroom. Teachers who trust in their own talents are more likely to persist in tough circumstances and seek professional development chances to enhance their skills. Furthermore, math instructors who have high self-efficacy are more likely to employ a range of teaching approaches, to offer clear and constructive feedback to students, and to establish a good and engaging learning environment. They are also more successful in motivating and encouraging students to take an active interest in the topic (Sugestiet al., 2022)

Mathematics instructors may take various actions to establish a strong feeling of self-efficacy. They might, for example, create precise, attainable objectives for themselves and their students and then strive to achieve these goals. They may also solicit feedback from colleagues and students and utilize it to improve their teaching techniques and tactics. They may also participate in professional development activities and seek mentorship or coaching to help them enhance their skills and knowledge (Gul, Tahir, et al., 2020; Gul, Zakir, et al., 2021; Said et al., 2021).

Furthermore, mathematics instructors may use self-reflection to assess their own performance and find areas for growth. This technique may assist individuals in identifying their strengths and limitations as well as setting personal development objectives. Self-efficacy is an essential characteristic for mathematics instructors to have. It may result in a more positive attitude toward the topic, a desire to take on difficulties, and improved student achievement. Teachers may boost their feeling of self-efficacy by defining clear objectives, soliciting feedback, participating in professional development, and engaging in self-reflection. All of these elements lead to a more productive and prosperous teaching profession (Tacr & Ozder, 2022).



Teachers that have strong self-efficacy have more favorable views regarding teaching and are more effective teachers. Teachers with high self-efficacy, for example, were more likely to employ a range of teaching strategies and to offer students with clear and constructive feedback. They also tended to provide a more pleasant and engaging learning environment, which resulted in improved student performance (Batool et al., 2021; Gul, Kanwal, et al., 2020; Gul et al., 2023; Muhammad Tufail et al., 2022; Salameh et al., 2022).

Mathematics instructors may take various actions to establish a strong feeling of self-efficacy. They might, for example, create precise, attainable objectives for themselves and their students and then strive to achieve these goals. They may also solicit feedback from colleagues and students and utilize it to improve their teaching techniques and tactics. They may also seek professional development programs and mentorship or coaching to assist them enhances their skills and expertise. Furthermore, mathematics instructors may use self-reflection to assess their own performance and find areas for growth (Ayub, Gul, Ali, et al., 2021; Ayub, Gul, Malik, et al., 2021; Batool et al., 2022; Gul, Ayub, et al., 2021; Gul, Tahir, et al., 2021). This technique may assist individuals in identifying their strengths and limitations as well as setting personal development objectives. Self-efficacy is an essential characteristic for mathematics instructors to have. It may result in a more positive attitude toward the topic, a desire to take on difficulties, and improved student achievement. Teachers may boost their feeling of self-efficacy by defining clear objectives, soliciting feedback, participating in professional development, and engaging in self-reflection. All of these elements lead to a more productive and fruitful teaching career. To establish an effective and happy learning environment for their students, instructors must believe in themselves and their talents (Batool et al., 2021; Gul, Kanwal, et al., 2020; Gul et al., 2023; Muhammad Tufail et al., 2022; Salameh et al., 2022).

Self-efficiency skills of a mathematics teacher can have a significant impact on their ability to effectively teach and engage students. These skills include things like self-confidence, self-motivation, and the ability to manage their time and workload effectively. When a teacher has high levels of self-efficiency, they are better able to create engaging and effective lesson plans, respond to the needs of individual students, and manage the classroom environment. This can lead to improved student learning outcomes, such as higher test scores and better engagement in the subject matter. Additionally, teachers with high self-efficiency are also more likely to have positive relationships with students, parents, and colleagues, which can lead to a more positive and productive learning environment for all. Self-efficiency skills refer to the ability of a teacher to effectively manage their own personal and professional development, as well as their ability to manage their own learning. These skills are critical for a mathematics teacher as they play a vital role in the overall effectiveness of the teacher in the classroom (Marschallet *et al.*, 2022).

One of the most important aspects of self-efficiency skills for a mathematics teacher is the ability to plan and organize their own learning. This includes setting goals, identifying resources, and creating a plan for achieving those goals. It also includes being able to monitor progress and make adjustments as needed. By having strong self-efficiency skills, a mathematics teacher is better able to stay current with the latest teaching methods and technologies, which can greatly enhance their ability to teach mathematics effectively. Another important characteristic of self-efficiency skills for a mathematics teacher is the ability to manage their own time and workload. This includes being able to prioritize tasks, set realistic deadlines, and manage their own workload effectively. By having strong self-efficiency skills, a mathematics teacher is better able to manage their own time and workload, which allows them to devote more time to their students and less time to administrative tasks (Hammad *et al.*, 2022).

Self-efficiency skills also play a vital role in a mathematics teacher's ability to create a positive learning environment for their students. This includes being able to create a classroom culture that is

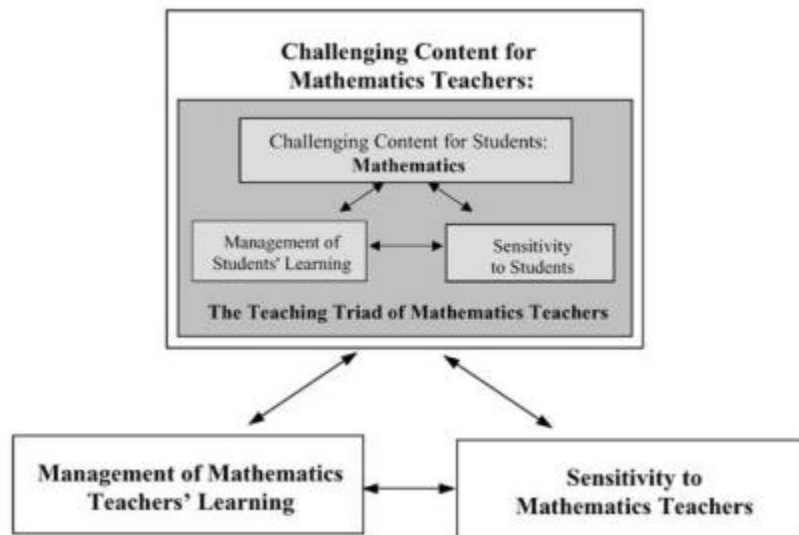


inclusive, respectful, and supportive. It also includes being able to build positive relationships with students, parents, and other teachers. By having strong self-efficacy skills, a mathematics teacher is better able to create a positive learning environment for their students, which can greatly enhance their ability to teach mathematics effectively.

As learners’ existing self-perceptions are emphasized in the theory, so both cognitive theory and self-efficacy theory are a part of it and the self-perceptions of the learners will powerfully sway how they will comprehend the victory or collapse of their recent efforts, and therefore their propensity to execute similar behavior in future (Gul, R., Tahir., Ishfaq, U., Batool, T. 2021; Bukhari, S, K, S.; Said, Hamdan; Gul, R; Seraj, P, M, I. 2021; Weiner, 1980, 1986, 2010; Assouline et al., 2006). Self-efficiency skills are also critical for a mathematics teacher’s ability to manage their own stress and maintain their own well-being. This includes being able to manage their own stress levels and maintain a healthy work-life balance. By having strong self-efficiency skills, a mathematics teacher is better able to manage their own stress and maintain their own well-being, which can greatly enhance their ability to teach mathematics effectively (Çiftçiet al., 2022).

Self-efficiency skills are critical for a mathematics teacher as they play a vital role in the overall effectiveness of the teacher in the classroom. It helps in planning and organizing their own learning, managing their own time and workload, creating a positive learning environment for their students and managing their own stress and maintaining their own well-being(Ahmad, Gul, & Imtiaz, 2022; Ali et al., 2021; Batool et al., 2022; Gul, Khan, et al., 2020). A mathematics teacher with strong self-efficiency skills will be better able to stay current with the latest teaching methods and technologies, manage their own time and workload, create a positive learning environment for their students, and manage their own stress and maintain their own well-being, which can greatly enhance their ability to teach mathematics effectively (Hammad et al., 2022).

The teaching triangle of mathematics teacher educators



Source: Zaslavsky&Leikin (2004).

The teachers thought that teaching and learning via projects was the best method to teach mathematics and would result in a more engaging learning experience for the students, but they did not apply this strategy in their previous teaching, namely the usage of investigations and groups. The projects were designed as small-group studies that questioned instructors' preconceptions about the



use of groups in the mathematics classroom. The opinions and attitudes of mathematics instructors concerning a new curriculum are likely to be intimately tied to their beliefs and attitudes toward their learning and teaching of it. If the teachers' ideas do not align with those defining the curriculum, it might have an impact on their degree of engagement and success in activities designed to assist them comprehend and apply the curriculum as intended. In general, instructors' ideas and attitudes may either facilitate or hinder their learning of the new curriculum (Zaslavsky&Leikin, 2004).

RESEARCH QUESTIONS:

1. What are the perceptions of Mathematics teachers about their professional development at secondary school level?
2. What is the impact of the Professional Development of Mathematics Teachers on their self-efficacy at the secondary school level?

RESEARCH OBJECTIVES:

1. To assess the perceptions of mathematics teachers about their professional development in mathematics.
2. To measure the impact of professional development on problem-solving skills of mathematics teachers.

SIGNIFICANCE OF THE STUDY:

This investigation had significant implications for educators, school principals, administration, educators, and teacher educators. Unfortunately, there are fewer students in Pakistan who are proficient in mathematics. Exams and recent research inquiries revealed that the vast majority of students failed this subject or passed it with average or below-average grades. Out of total selected population, sample size for questionnaire is 378 teachers.

Sample:

Table 1: Selection of sample (quantitative)

District	Rural	Urban	Total	10% of total
Abbottabad	1036	204	1240	124
Haripur	637	294	931	93
Mansehra	1220	389	1609	161
Total	2893	887	3780	378

INSTRUMENT

A questionnaire was developed for the research. It was a self-developed questionnaire. Data were collected through the questionnaire from the mathematics teachers. The questionnaire contained two portions. One is related to professional development contained 30 items and 2nd part consisted of professional development and self-efficacy of mathematics teachers also contained 21 items

Questionnaire was finalized after going through series of drafts and through these drafts items were added and deleted as suggested by supervisor and members. Furthermore, the draft was processed through the pilot testing for more refinements.



PILOT TESTING OF THE QUESTIONNAIRE

For study validation and reliability, pilot study was conducted in one university of Islamabad. The 10% of total students were selected for pilot testing which ended up selecting 37 mathematics teachers from Government Secondary Schools.

Validity

The validity of the scale was determined through the experts working in different universities and colleges. The suggested changes were addressed and tool is modified as required.

Reliability

The reliability of the scale is determined through Cronbach’s Alpha and all the statements are found reliable, that is the value of alpha is was acceptable.

Table 2:Coefficient Alphas for reliability statistics

Variable	No. of statements	Cronbach’s Alpha
Professional development	30	.833
Self Efficacy	21	.761
Problem Solving Skills	25	.811

Data Collection

The researcher personally visited the sample institutions of Hazara division for data collection. The questionnaires were personally administered by the researcher to collect data from respondents to fulfill the study. Few extra questionnaires were administered to control and avoid non-response or other issues.

DATA ANALYSIS

Professional Development on Self-Efficacy of Mathematics Teacher

Table

Emotional states

	SDA	Disagree %	Neutral %	Agree %	Strongly agree on %	Total
It is important that before being too friendly with the students, I begin to control the class.	6.3	17.2	19.8	31.7	24.9	378
As a teacher, I find that including activities that encourage students to broaden their perspectives is essential when creating lessons.	4.5	10.8	14.3	40.5	29.9	378
I give grades to the students based on their homework, quizzes, and tests.	3.9	7.6	19.8	44.4	24.3	378
As a Teacher, I am always ready to facilitate students’ families with problems in students	5.1	10.4	18.5	35.1	30.9	378



learning.

I teach students all content and skill with the help of textbooks and workbooks. 5.6 10.3 16.4 39.4 28.3 378

I teach the student all content which are overlap or separated. 6.6 9.1 19.3 40.4 24.6 378

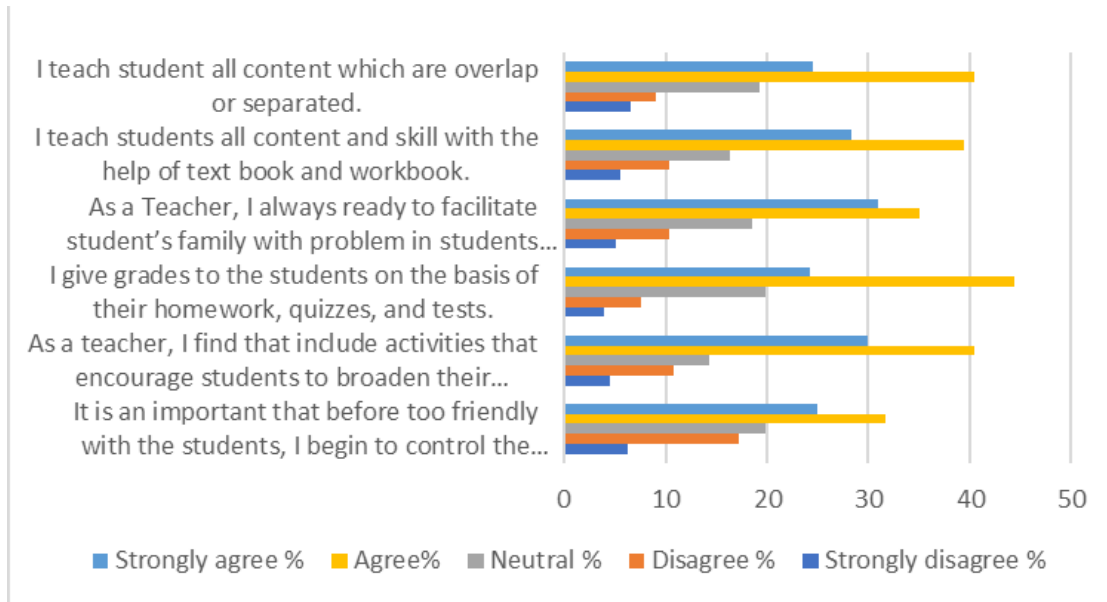


Figure Emotional states

Table shows that a majority of teachers agree or strongly agree that it is important to control the class before becoming too friendly with students (56.6%). Similar majorities (49.9%) also agree or strongly agree that it is essential to include activities that broaden students' perspectives. The majorities (64.7%) of teachers also agree or strongly agree on grading students based on their homework, quizzes, and tests. A slightly lower percentage of teachers (46.0%) agreed or strongly agreed that they are always ready to help students' families with problems in learning. A majority of teachers (48.3%) agreed or strongly agreed that they teach all content and skills using a textbook and workbook. Finally, a majority of teachers (65.0%) agreed or strongly agreed that they teach both overlapping and separated content to their students.

Table

Mastery experiences

	Strongly disagree%	Disagree %	Neutral %	Agree %	Strongly agree%	Total
A fixed schedule is a must for students' learning.	7.4	8.1	24	26.9	33.6	378
Homework assignments are an essential part of my lesson plan.	2.3	6.9	25.4	37.6	27.8	378
I appreciate students discussing conflicting ideas in the group.	6.1	9.3	13.5	45.8	25.4	378

I guide students when they are confused about the solution to a particular problem.	3.9	7.5	18.5	32.3	37.9	378
In my class parents are allowed to visit at any time.	5.3	10.8	16.2	37.4	30.3	378
To assess student performance through informal approaches.	7.0	9.8	12.3	45.2	24.3	378
To play the role of the teacher as well as a learner in an effective manner.	6.6	12.3	22.0	32.5	26.6	378
To support the curriculum through the textbook and Published material	5.0	11.3	15.6	38.7	29.4	378

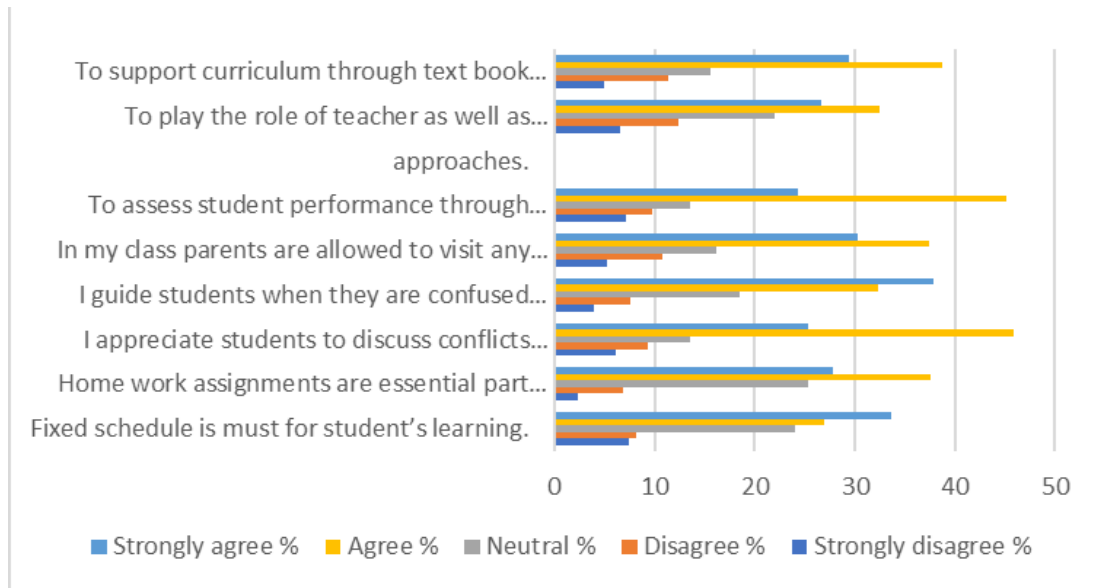


Figure Mastery experiences

Table and fig show that the majority of the teachers surveyed (about 33-45%) agree or strongly agree with the statement that fixed schedules are not necessary for student learning, that homework assignments are a crucial part of their lesson plans, that they appreciate students discussing conflicting ideas in groups, and that they guide students when they are confused about a problem. Around 25-30% of the teachers surveyed neither disagrees nor agrees with the statement that they allow parents to visit their class anytime. However, a higher percentage of teachers (about 45%) agreed that they assess student performance through informal approaches. The results also show that around a quarter to a third of the teachers surveyed either disagree or strongly disagree with the statement that they play the role of both teacher and learner effectively and that they support the curriculum through textbooks and published materials.



Table

Regression Analysis of Professional Development on Self-Efficacy

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.068a	.005	.002	18.82596	.005	1.745	1	376	.187

Note: a. Predictors: (Constant), professional development

In this regression analysis, the dependent variable is “Self Efficacy” and the independent variable is “Professional Development.” The model shows that the R-squared value is .005, which means that the independent variable only explains .005 or 0.5% of the variation in the dependent variable. The adjusted R-squared value is .002, which means that after adjusting for the number of predictors in the model, the independent variable only explains .002 or 0.2% of the variation in the dependent variable.

DISCUSSION & CONCLUSIONS:

This study contributes to the existing literature by providing empirical evidence on the relationship between professional development and teachers' self-efficacy and problem-solving skills. The results suggest that while professional development may have some impact on these skills, it may not be as strong as expected. It is also possible that other factors such as prior experience and education may play a larger role in determining a teacher's self-efficacy and problem-solving skills. In conclusion, the findings of this study highlighted the need for further research to better understand the relationship between professional development and teachers' self-efficacy and problem-solving skills. Additionally, education policymakers need to consider these findings when designing and implementing professional development programs for teachers, to ensure that they are having the desired impact on teachers' skills and competencies. The findings are also beneficial for developing countries whose demographic and economic conditions are like Pakistan, for example, India, Sri Lanka, and Bangladesh, etc. where the education sector specifically at the rural side is confronting similar issues as in Pakistan. (Gul.R., T.Tahir .U.Ishfaq2023) A formal coordination mechanism should be developed between the Provincial Institute of Teacher Education (PITE) and the Directorate of Schools to ensure transparent selection of teachers, realistic needs assessment and feedback mechanism and enhance provincial capacity to develop, implement and review quality in-service teacher training. While teachers endeavor to find new methods to interact with their students via technology, we must pay close attention to what we are teaching to our students (Ayub, Gul, Malik, et al., 2021; Gul, Kanwal, et al., 2020; Gul & Rafique, 2017; Gul & Reba, 2017; Khan et al., 2023; Saleem et al., 2021; Sohail et al., 2018). The study recommends that courses must be based on students' experiences and should encourage dynamic and versatile thinking, compassion, and tolerance among students. Teachers should be prepared to act as a facilitator. This shift from traditional teaching to online may provide ample opportunities for teachers for self-learning by studying from a range of platforms and support customized learning. The instructors should be trained as “competent” individuals who can go with students' expectations (Gul et al., 2021)

STUDY IMPLICATIONS:

Consideration of study findings by education policymakers: Education policymakers should consider the findings of this study when designing and implementing professional development programs for teachers to ensure that they are having the desired impact on teachers' skills and competencies. Recognition of the role of other factors: The study suggests that while professional development may have some impact on teachers' skills, other factors such as prior experience and education may play a larger role. Education policymakers should take this into consideration when developing professional development programs. Align professional development with specific needs: To ensure that




professional development programs are effective, they should be tailored to the specific needs of teachers. This could be achieved through needs assessments or evaluations of teachers' skills and competencies. Encourage collaboration and peer learning: Professional development programs should encourage collaboration and peer learning among teachers. This can facilitate the sharing of best practices and the development of problem-solving skills. Provide ongoing support: Professional development should not be a one-time event, but rather an ongoing process. Education policymakers should provide ongoing support for teachers to reinforce and sustain the skills and competencies that they have developed through professional development. The teachers' judgment of the children's strengths, weaknesses and needs are imprudent, and the quality of instruction they obtain in regular classrooms is affected. It is also necessary to mention here that teacher education curriculum is not based on scientific evidence, that is why they do not study the educational problems of learners, rather teacher education curriculum is merely based on their formation of teachers. (N.Gul. T.Tahir 2021)

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