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Experts teachers' point of view on mathematics teachers' readiness in becoming professional teachers

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ABSTRACT

Today's educational changes necessitate that teachers have a broad range of knowledge, values, skills, and competencies to provide effective instruction. Despite this, research on mathematics teachers' readiness for such changes is limited, particularly in terms of leveraging experienced teachers' implicit knowledge for peer learning. This qualitative exploratory study delves into the perceptions and factors influencing mathematics teachers' readiness for educational changes, as reported by four expert teachers. Note that data was collected through semi-structured interviews and analyzed thematically with Atlas.ti 23 software to identify key themes and subthemes. The findings reveal that all experts emphasized the importance of professionalism in teaching mathematics, with pedagogical challenges taking priority. The main challenges include mastering teaching skills, which are critical to teacher readiness. Consequently, the study concludes that improving teacher readiness necessitates specific support and focused programs. This highlights the importance of a comprehensive model that addresses the pedagogical needs of mathematics teachers, who play a critical role in change. Further research should focus on investigating mathematics teachers' readiness in a broader context, emphasizing their professional knowledge and pedagogical skills.

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1. INTRODUCTION

Professionalism is associated with accountability, competency, and behavior in performing a task [1], [2]. During these two decades, the teachers' professional identity has often been debated among previous researchers, and various initiatives have been taken in the context of teaching and teacher education [3], [4]. Mathematics teachers who are professional in teaching can improve their practices and further increase students' interest in learning [5], [6]. Furthermore, teacher professionalism can be enhanced through specialized training and self-study with the aim that their field of work can be better understood and the quality improved [7].

Teacher professionalism needs to be emphasized so that mathematics teachers can achieve the current education standards [8]. Currently, mathematics education intends to ensure and prepare students with various abilities and the propensity to compete globally. To achieve this goal, emphasis on new knowledge, innovation, creativity, and effective communication should be the focus [9], and changes need to be made [10], [11]. Therefore, teachers are essential individuals as agents of change to ensure education quality [12] and the effectiveness of teaching sessions [13]. In addition, the teaching approach and the role of mathematics teachers need modification to align with the education revolution [14].

In order to adapt to change, earlier studies have discussed a number of problems and difficulties that teachers encounter. Notably, the process of teaching and learning is quite complex to put into practice. Teachers not only need to master the content but are also influenced by skills, experience, and environment [15]. Teachers' desire to improve their teaching [16]–[18] can encourage them to achieve their teaching goals [19]. However, changing the way of teaching and learning is not a new thing. Moreover, teachers still tend to adopt traditional approaches even though they are aware of the importance of student-centered teaching [20].

Lack of confidence is a contributor to the failure to implement effective teaching. Livy *et al.* [21] mentioned that mathematics teachers lack the confidence to make and present good examples to students. Meanwhile, Pourdavood and Song [22] discovered that one-third of the study participants refused to implement online teaching sessions. This problem does not only occur among pre-service teachers but is also encountered by experienced teachers. In addition, extensive research has proven that mathematics teachers' readiness is crucial and impacts student achievement [23], [24].

Malaysia also faces issues and challenges involving the readiness of mathematics teachers [25], [26]. Several studies have been conducted to determine the level of readiness of teachers for the implementation in science, technology, engineering, and mathematics (STEM) education, and the results remain moderate [27]–[29]. When there is a change, teachers need time to understand and adapt [30]. Although the readiness of teachers attracts attention among foreign and local researchers, there is still a lack of research involving mathematics education, especially the epistemological aspect [31]–[33]. Realizing the gap in the literature, it becomes a necessity to explore the readiness of mathematics teachers to accept and implement changes in education [10], [30]. In order to gain a deep understanding of the mathematics teachers' readiness to become professional teachers from an expert teacher's point of view, two research questions have been formulated:

- What are the issues and challenges faced by mathematics teachers from a pedagogical aspect?
- What factors are considered to affect the readiness of mathematics teachers to become professional teachers in mathematics education?

2. MATHEMATICS TEACHERS' READINESS

2.1. Implementation of educational change

Fullan's articles provide valuable insights into the role of teachers as agents of change in education [34]–[39]. Fullan emphasized the importance of teacher development and school reform in reshaping the professional teaching culture. He also highlighted the need for teachers to become moral change agents to create powerful cultures that can make a difference in students' learning outcomes. This emphasis on teacher development as a crucial factor in driving meaningful change in schools is still highly relevant today. Moreover, Fullan [39] discussed change theory as a force for school improvement, highlighting the need for a new mindset among teachers to become agents of change rather than victims. In the current educational landscape, where teachers increasingly need to adapt to changing circumstances and drive innovation in their practice, this call for a shift in mindset is crucial [38].

Furthermore, Fullan [34] discussed the importance of collaborative inquiry processes involving teachers, administrators, and parents in making lasting and meaningful changes in school culture. This collaborative approach to change aligns with current trends in education that emphasize the value of teamwork and shared leadership in driving school improvement efforts. Additionally, Fullan [35] stressed the need for teacher educators to take the initiative to drive change within the education system. This assertion remains pertinent today as educators play a critical role in shaping the future of teaching and learning.

In today's context, the idea of teachers as moral change agents, as discussed by Fullan [40], is still highly relevant. The need for teachers to have a deep understanding of the subject matter, effective teaching strategies, and the ability to influence their surroundings is as crucial now as when these articles were written. Moreover, the call for continuous learning and the strengthening of moral purpose and change agency among teachers, as highlighted by Fullan [38], remains a key focus in modern teacher education and professional development initiatives. Overall, the insights provided in these articles by Fullan and other researchers continue to offer valuable guidance for teachers seeking to drive positive change in schools and communities today.

2.2. Mathematics teaching and learning practice

To date, several studies have explored mathematics teachers' readiness, focusing on their organizational and administrative aspects. The study employs a mixed-methods approach, combining qualitative and quantitative methodologies to investigate the teachers' preparedness to utilize technology and adapt to new teaching methods [41]–[43]. Qualitative data collection methods include interviews, thematic analysis, and implicative analysis, while quantitative data are analyzed using statistical implicative analysis

children's hepatic tumors international collaboration (C.H.I.C). The research aims to identify the teachers' willingness to implement digital technologies in their lesson plans and the impact of the COVID-19 pandemic on their teaching practices [44].

Previous research has demonstrated that mathematics teachers are moderately prepared to use digital tools, focusing on testing and feedback collection [45], [46]. The teachers primarily concentrate on the content and choice of software when preparing lesson plans. In addition, the thematic analysis identifies codes related to the hybrid teaching mode, indicating a shift towards incorporating technology in educational practices. However, not all identified codes are interconnected, suggesting areas for further improvement in teachers' readiness to integrate digital tools effectively.

In another study, Uteuliyev *et al.* [47] emphasized the importance of teacher educators and in-service teachers in enhancing mathematics teachers' readiness in the online environment. By focusing on lesson planning and the use of digital tools, the study provides insights into the challenges and opportunities for professional development in mathematics education. The findings are relevant for teacher training programs and educational policymakers seeking to enhance teachers' competencies in utilizing technology and adapting to new teaching methodologies. Additionally, the research contributes to the ongoing discourse on teacher readiness and integrating digital tools in mathematics education, highlighting the need for continuous support and training to improve teaching practices in the digital age.

However, several noticeable gaps in existing research on mathematics teachers' readiness can be identified. Firstly, there is a lack of longitudinal studies tracking teachers' readiness over an extended period [48]. Meanwhile, the current research provides insights into teachers' readiness at a specific point in time. Longitudinal studies could offer a more comprehensive understanding of how teachers' readiness evolves and fluctuates in response to changing educational landscapes, technological advancements, and professional development initiatives [41]. Thus, by conducting longitudinal research, scholars can capture the dynamic nature of teachers' readiness and identify factors that contribute to sustained growth or potential setbacks in integrating technology and new pedagogical approaches.

Secondly, there is a need for a more in-depth exploration of the challenges and barriers that hinder mathematics teachers' readiness to adopt digital tools and innovative teaching methods [44]. The existing studies touch upon teachers' willingness and ability to integrate technology, and there is limited discussion on the specific obstacles they face in this process. Understanding the nuanced challenges, such as lack of institutional support, inadequate training opportunities, or resistance to change, can inform targeted interventions and support mechanisms to enhance teachers' readiness effectively [49]. Thus, by delving deeper into the barriers that impede teachers' readiness, researchers can provide actionable recommendations for addressing these challenges and promoting a more conducive environment for technology integration in mathematics education.

Lastly, there is a gap in research focusing on the impact of external factors, such as policy changes or societal influences, on mathematics teachers' readiness [44]. The current studies primarily examine individual teachers' attitudes and practices. Broader systemic factors that shape teachers' readiness remain underexplored [50], [51]. Hence, investigating how policy frameworks, curriculum reforms, or societal expectations influence teachers' readiness can offer valuable insights into the macro-level dynamics that shape educational practices [42], [47]. Therefore, by considering the interplay between individual teacher readiness and external contextual factors, researchers can provide a more holistic understanding of the complexities surrounding transformation in mathematics education and inform evidence-based strategies for promoting teachers' readiness at both the micro and macro levels.

3. RESEARCH METHOD

A qualitative approach is used in this study to enable the researcher to understand the readiness of mathematics teachers as well as to explore forms and activities that can improve the teachers' professionalism in mathematics education [52]. In today's context, the qualitative approach has been widely used in foreign circles and locally. Thus, by applying a qualitative approach, researchers can understand a phenomenon in depth [53] based on individual or group knowledge and experience [54], [55].

The data collection of this study used a semi-structured interview method. Semi-structured interviews allow the researcher flexibility in asking in-depth questions [56] in addition to being guided by the developed interview protocol [57]. The interview protocol that was developed consists of three parts, namely the information of the study participants, understanding of the readiness of mathematics teachers, and forms of activities that can improve the teacher's professionalism. The data collection period took two weeks, and each interview session lasted 120 minutes. A long interview period was conducted to allow the data to reach saturation point before the final theme was obtained.

In this study context, purposive sampling is used to determine and select the study participants based on criteria set by the researcher [58], [59]. A total of four mathematics expert teachers were selected as study participants to obtain extensive information based on experience and expertise in the teaching and learning process [60], [61]. Their expertise was recognized by the Malaysian Ministry of Education based on their teaching performance, contributions, and awards they received [62], [63]. In addition, their contribution to the academic improvement of students is highly admired and can be emulated. Table 1 is a summary of the background of the study participants.

Table 1. Interviewee background

Interviewee identifier	Gender	Academic qualifications	Teaching experience (years)	Specialization	Interview duration (minutes)
PK01	Female	Masters	15	Mathematics	120
PK02	Female	Masters	15	Mathematics	120
PK03	Female	Bachelors	16	Mathematics	120
PK04	Male	Bachelors	20	Mathematics	120

After the interview session, the audio recordings are transcribed for documentation purposes. Interview data was collected and then analyzed using thematic analysis. The data analysis process is conducted in six stages, as suggested by Braun dan Clarke [64], from understanding the collected data to writing the findings report. Notably, the data analysis of this study is not linear, as it requires research and re-categorization to obtain a clear and accurate interpretation [63]. The coding and thematic process was performed using Atlas.ti 23 software.

This study employs several validity and reliability strategies to increase the accuracy, consistency, and credibility of the study findings [65], [66]. Among the strategies used are pilot studies, peer review, member checking, audit trail, and time spent in the field [67]–[69]. Unlike the quantitative approach, the validity and reliability aspects occur simultaneously during the data collection and analysis. For example, when the interview session is conducted, the researcher also makes memo notes related to ideas and information that need to be refined to facilitate the data analysis. Meanwhile, the audio of the transcribed interview was provided to each study participant for review purposes to ensure the information presented was accurate and appropriate. At the end of the interview session, the researcher was also informed about the review of the transcription and the study participants' consent to the interview session conducted. All study participants agreed with the data analysis performed and offered no revisions. Details of the themes and findings of the study will be discussed in the next section.

4. RESULTS AND DISCUSSION

In-depth interviews with four mathematics experts revealed research findings about mathematics teachers' readiness to become professional teachers. In this paper, the abbreviations PK01, PK02, PK03, and PK04 refer to the four study participants. It seeks to prevent the identities of study participants from being discovered. Thematic analysis revealed three themes related to mathematics teachers' readiness to become professional teachers. Meanwhile, inductive thematic analysis identified themes based on participant responses rather than pre-existing theory or research. These themes included i) issues and challenges faced by mathematics teachers from a pedagogical aspect, ii) experts' teachers' views related to the readiness of mathematics teachers, and iii) factors that are considered and affect the readiness of mathematics teachers to become professional teachers (as provided in Table 2). The report's writing discusses the results in order. The purpose is to provide explanations and aid comprehension of the research findings presented in descriptive and interpretive forms. The subsequent sections analyze each of these themes and their corresponding subthemes, with supporting quotes from exemplary study participants.

Table 2. Themes and sub-themes (n = 4)

Themes	Subthemes
Issues and challenges faced by mathematics teachers from a pedagogical aspect	– The reality of teaching skills mastery – Lack of exposure – Limited understanding of content
Experts' teachers' views related to the readiness of mathematics teachers	Needed
Factors that are considered and affect the readiness of mathematics teachers to become professional teachers	– Teacher priority – Personality competencies – Pedagogical competencies – Commitment to change

4.1. Issues and challenges faced by mathematics teachers from a pedagogical aspect

The discussion of the results begins with the issues and challenges faced by mathematics teachers from a pedagogical perspective. In today's increasingly challenging world, various initiatives need to be taken to ensure that mathematics teachers are always ready to face challenges and changes in education [70] and continuously improve their professionalism [22]. The issues and challenges faced by mathematics teachers today involve novice teachers and teachers who are in service and experienced [70], [71]. Hence, it is vital to focus teachers' attention on the mathematical and pedagogical aspects of teaching. Four study participants agreed that three issues and challenges in the pedagogic aspect are always the concern of mathematics teachers.

First, the reality of mastery of teaching skills [72]. Teachers must be strategic in selecting appropriate methods and strategies. Therefore, mastery of pedagogical skills is required to deliver teaching sessions that are both clear and interesting. Participants described teaching skills as highly important but also complex and challenging. However, the disparity between theory and field facts affects student learning outcomes. For example, the application of appropriate teaching skills to encourage students to read and understand math questions. The study participants' expressions related to this challenge are conveyed as follows:

> *"That is another weakness of mine because students do not want to read long questions. So, even that needs to be from the teacher, how to encourage the student to read the question." (PK01)*

Rather than directly influencing student learning, teacher characteristics may influence how teachers teach, influencing student learning [17], [18]. This view was echoed by PK02 and highlights the role of teachers in encouraging active student involvement [73].

> *"Why are they weak in mathematics, and the way of their thinking, to extract all the variables is a challenge. So, I think the teacher's role in driving the students to extract the variable is also a challenge." (PK02)*

Secondly, a pedagogical issue and challenge is that mathematics teachers have less exposure. Teachers struggle to keep up with the ever-changing educational system due to a lack of in-service training and personal development opportunities [21], [72]. Most study participants agreed they received less exposure, especially when introducing a new program or approach. The training obtained at the beginning of the service alone is not enough [70], [72]. There needs to be an initiative to improve the knowledge and skills of teachers. Here are some quotes that can illustrate this point.

> *"I think teachers need to be given a lot of exposure about diversity in teaching, how to teach a concept." (PK01)*
> *"I think most math teachers experience the same problem. We lack exposure to what needs to be emphasized in the topic. The topic is broad, so what aspects do we want to emphasize? How do we want to teach a simple method to students." (PK03)*

Aside from that, this occurred due to a lack of reference materials. This will challenge teachers in selecting appropriate media, applying established theories, maintaining classroom management, choosing suitable assessment tools, and accurately evaluating teaching and learning activities [74]. For example, one interviewee mentioned:

> *"Even if they give structured questions, most students and teachers find it difficult to convey it. One reason is that we lack references." (PK02)*

Third, content understanding plays a significant role in the pedagogical issues and challenges that teachers face. All study participants agreed that content understanding is closely related and will affect the teacher's teaching process in the classroom [75]. Although mathematics teachers are ready to implement a lesson, their limited understanding and knowledge make it challenging to convey a mathematical concept to students [19]. These inconsistencies can pose a risk to mathematics teachers and affect their credibility as professionals in their field. This can be observed in the following verbatim quote:

> *"This kind of exposure is important if the teachers do not know how they want to teach the students. That is why teachers need to have enough time to do self-learning before teaching. So, it might have an impact if the teacher is not competent to deliver new content in KSSM." (PK01)*

"The topic is really challenging because, like I said before, the teachers are still adapting, right? It has only been two years of teaching that topic, so they still want to find a rhythm, and they still try to understand the topic." (PK02)

These results suggest that we need to refine and overcome pedagogical issues and challenges [76]. Aspects of mathematics pedagogy influence teacher behavior during the teaching process [76], [77]. Thus, support from various parties, including stakeholders, school administration, teachers, parents, and the community, can help overcome challenges and issues that limit pedagogy. Aside from the aspect of service training, reference sources are still limited. Therefore, it is necessary to develop guidelines and models to help teachers implement an effective teaching process and make it suitable in Malaysia.

4.2. Teachers' views related to the readiness of mathematics teachers

Readiness is an essential and decisive aspect of mathematics teacher professionalism [78], [79]. Being adaptable to change allows the teacher to be more creative and then structure the teaching process. Furthermore, mathematics teachers' confidence can be enhanced and translated through behavior in the classroom. Change necessitates specific abilities and perceptions, encompassing intellectual and emotional components. PK02 stated:

"I think it is relevant for now, and I hope this model can help me and my math teachers and friends to be more prepared and skilled to teach math in the future." (PK02)
The concern expressed about the low readiness of mathematics teachers can impact the country's education system. From an individual perspective, readiness includes several elements, such as motivation, competence, and personality attributes. One participant felt that:
"It is necessary because we want to go together. We want to coordinate. It means that if the teacher cannot master it, the students cannot learn or even do not succeed in the learning process. So, we do not want to say that my school is successful, but other schools are not. It would not achieve the MOE's aspiration." (PK04)

Overall, these results reveal that all the study participants agree that the readiness aspect of mathematics teachers is necessary. The reported results highlight the need to emphasize mathematics teachers' readiness in terms of knowledge and skills to ensure an effective teaching process [15], [40]. As a result, enhancing and maintaining support for mathematics teachers' readiness is critical, as many psychological elements and experiences influence their knowledge and skills.

4.3. Factors that are considered and affect the mathematics teachers' readiness to become professional teachers

The next factor is how to examine in detail the factors that affect mathematics teachers' readiness to become professional teachers. Firstly, the teacher's priority. Teacher priorities in mathematics education are primarily focused on improving teaching quality and fostering professional development in the discipline. This comprises actions and collaborative efforts to improve teaching quality and promote positive change throughout the profession [80]. According to PK02, teachers need to prioritize matters related to teaching diversity as follows:

"In my opinion, teaching mathematics today, we need to use various modes. This means that the textbook itself has now been upgraded to the latest curriculum format." (PK02)
This is also supported by PK03;
"For me, the approaches introduced are good in that we know how we want to plan our teaching process. So that it is better and more effective." (PK03)

As a professional, the teacher is an agent who delivers the curriculum to ensure that national education objectives are achieved. Therefore, matters involving curriculum development and change always receive the attention of mathematics teachers, especially in curriculum implementation, such as delivery methods appropriate to the student's cognitive level [81]. Among the statements of research participants that support this matter are as follows:

"The KBSM (The Integrated Curriculum for Secondary Schools) textbook is more towards giving questions and then how to solve them. But if we look at the KSSM (The Revised Standard Based Curriculum for Secondary Schools) book, it is more into exploration. Every concept has an exploratory activity. So, it stimulates the mind." (PK01)

"Even though we have been teaching for a long time, we had already known that thing. But actually, education is something that keeps developing. there will always be changes in it." (PK03)

The second factor is personality competencies. Competencies are regarded as personal abilities demonstrating a teacher's strong and solid personality. This competency can be measured by the behavior and performance of mathematics teachers in the classroom [82]. To face changes, teachers must be proactive and enhance their knowledge and skills through self-learning. The following are some of the interview responses of the study participants:

"They really want that thing. That is indeed one of the ways we can do so that we can improve teaching techniques." (PK03)
"Because, when we are in school, we as teachers have to take the opportunity. Take the opportunity to experience the way of working at the district level, state level, and national level." (PK04)
"I did a lot of self-studies, ma'am. Before teaching, I did self-studies because I did not want to get trapped while teaching." (PK01)
"For example, we have many online courses. We have many open channels such as YouTube. We cannot actually just rely on reading; we can also explore through YouTube and courses." (PK02)

Next, the third factor is the pedagogical competencies. This aspect includes the ability of mathematics teachers to manage and control the teaching and learning process. Murray *et al.* [83] also emphasized that mathematics teachers must be competent to teach mathematics to students. In this study, most respondents suggest that pedagogical competencies can be improved by sharing best practices. This sharing session is one of the efforts that mathematics teachers can use as a medium to generate ideas, increase creativity potential, and catalyze excellence. Among the participants' answers are:

"The way we taught that was easy, we can share it with our friends in the committee. So that they can use our simple approach to teach their students." (PK01)
"Many teachers produce videos of (various) content and topics. When we search for one topic, there are more videos than before. That actually helps us to improve the teaching content, especially those that are not mastered like new chapters." (PK03)

Furthermore, the teacher's teaching style consistently influences meaningful learning. Teachers who are creative in diversifying teaching strategies and techniques can build a meaningful learning environment and improve the quality of mathematics teacher professionalism [12]. This is explained by PK03;

"Nowadays, the teacher has to be more creative to attract students' interest. Another thing is to be parallel with the students' thinking. It is like some of the teachers have joined TikTok, not for fun. But we use those mediums to approach our students. So, more creative, and there is a sense of competitiveness as well." (PK03)

The last factor is the commitment to change, which includes the behavior of mathematics teachers to support change [84]. Mathematics teachers should perceive a change as an opportunity as it can indirectly improve their knowledge and skills. In this context, some participants expressed agreement with the following statement:

"In my opinion, KSSM (The Revised Standard Based Curriculum for Secondary Schools) actually makes us more diligent as teachers to introduce all topics and emphasize all topics compared to KBSM (The Integrated Curriculum for Secondary Schools). And if that is the case, it is advantageous to our students." (PK02)
"Actually, in terms of marking, there is a lot of experience. This experience can help in terms of pedagogy, especially the techniques of how to conceptually and procedurally understand students." (PK04)

PK01 and PK02 also believe that mathematics teachers should have the characteristics of openness, especially in the teaching process. Normally, openness allows math teachers to be willing to explore and adapt to changes [10]. This situation will encourage mathematics teachers to think creatively and innovatively.

"I think as a teacher, we need to accept it openly. If we are blocked at the first stage, of course, we cannot move forward." (PK01).
"I think the way we teach now; we need to change with the times. And we know that today's students are very digital." (PK02).

According to the results reported here, four factors are considered and influence the readiness of mathematics teachers to become professional teachers. The four factors are teacher preference, personality competencies, pedagogical competencies, and commitment to change. Teachers are essential individuals to drive the success of educational reform. Notably, a high level of readiness among mathematics teachers enables them to perform their responsibilities in the classroom effectively [16], [85], [86]. These results suggest that enhancing mathematics teacher readiness requires considering professional knowledge and pedagogical skills. However, further research is required to better understand mathematics teachers' readiness to act as agents of change based on professional knowledge and pedagogical skills.

5. CONCLUSION

Epistemologically, this study's findings provide an overview of the readiness of mathematics teachers to become professional teachers. As a professional in the field, the teacher's readiness to face change is vital. Findings reveal that most mathematics teachers state that the main issues and challenges in education involve pedagogical aspects. Pedagogical issues and challenges must be explored and addressed to ensure the country's education system is on track. However, due to limited knowledge and skills, teacher readiness is moderate. As a result, mathematics teachers are more inclined to implement a teacher-centered teaching process. Additional findings also exhibit several factors that are considered and affect the readiness of mathematics teachers, such as the teacher's priorities. This finding holds significant implications for providing supportive resources, which can serve as guidance and raise awareness for practices like model development. Furthermore, the study participants recommended continuing exposure and in-service training to improve teachers' professionalism. The training program extends beyond pre-service teachers to include in-service mathematics teachers. This study utilized a qualitative approach to gain a preliminary understanding of mathematics teachers. Therefore, future studies need to conduct rigorous and systematically designed research on mathematics teachers and expert groups who can provide in-depth information. Accordingly, mathematics teachers, along with other stakeholders like training providers and curriculum developers, can utilize the obtained data. Parallel to the transformation of the education world, the readiness of mathematics teachers to become professional teachers can improve their pedagogical competency and further increase students' academic achievement based on their needs.

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