

Mathematics pre-service teachers' readiness and the contributing factors

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Abstract

Pre-service teachers are expected to shape excellent education in the nation. However, their readiness for the teaching profession remains uncertain, as their ability to address challenges significantly influences their preparation. As technology integration progresses, the challenges of teaching mathematics are increasing. It is crucial to identify the most current factors that affect pre-service teachers' readiness to teach mathematics, thereby ensuring a promising future for mathematics educators. Hence, this study was designed to investigate the key teaching factors that influence pre-service teachers' readiness in the endeavours. Using a quantitative approach and focusing on a correlational research design, this study investigated the relationship between readiness and the relevant factors. A stratified random sampling was employed to select 118 students from a public university in Malaysia to answer the questionnaire. The findings revealed that pre-service teachers' valuing, motivation, and health and safety issues had moderate positive correlations with readiness to teach mathematics, while teaching-learning conditions and parents' educational backgrounds had weaker correlations. The regression analysis also showed that the three factors—pre-service teachers' ideas about the value of math, their motivation, and their concerns about health and safety—explained 47.3% of the variation in readiness. Parents' educational backgrounds and how they saw their children learning did not affect the model. This study provides universities with guidelines for designing effective programmes to improve pre-service teachers' readiness to teach mathematics.

Keywords: Contributing factors to readiness, pre-service teachers, professional knowledge, professional practice, professional engagement, self-management

Introduction

When the world copes with unemployment as a critical current issue, the focus always shifts to graduates, as they are the primary drivers of economic growth (Hussin & Chan, 2023). These current issues also remind pre-service teachers of their responsibilities. In addition to considering employability, pre-service mathematics teachers are embarking on career endeavours in accordance with the transformation of digital education and AI development, which requires them to confront vast challenges. Recently, many pre-service mathematics teachers in Malaysia have faced increased challenges due to the competitive nature of securing jobs as secondary public school mathematics teachers. Private schools may offer alternative employment opportunities, but they must demonstrate their ability to overcome challenges. Therefore, developing a strong level of readiness is crucial to meeting the demands of the career. Moreover, it is becoming crucial to investigate to what extent pre-service teachers prepared themselves for their future teaching, as the current environmental trends may impact their performance and moderate their readiness.

Colleges or universities expect pre-service teachers to receive extensive training to adequately prepare them for their roles as educators. Ideally, the trainings facilitate them to enhance their engagement in the teaching field, enabling them to gain experience and acquire relevant teaching strategies and approaches, thereby enhancing their pedagogical competence and performance (Mufidah, 2019). Consequently, microteaching programs are designed to meet these needs (Meutia et al., 2018). Pre-service teachers have long recognized microteaching as a

valuable practice that provides them with the opportunity to gain pedagogical skills and improve their performance in teaching practicum. Besides, they are urged to be independent and learn from their teaching experience (field experience, practicum) to develop their professional skills (Mena et al., 2017). While STEM education is getting more attention, they consistently receive additional guidance, especially in advancing their knowledge in areas like STEM and 21st-century teaching skills (Teoh et al., 2022; Teoh et al., 2024; Ventista & Brown, 2023). Therefore, understanding their current level of development is crucial for offering suggestions for future enhancements. Mentoring plays a crucial role in maintaining professional engagement, as they aspire to fulfil their training requirements and acquire professional knowledge. Furthermore, they are expected to establish their own professional development to secure a teaching career.

Essentially, they are expected to demonstrate their preparedness by fostering positive self-management, prioritizing the environment in their teaching activities, and taking responsibility for their tasks as they are always observed for their competency in teaching. Similarly, in the context of mathematics, pre-service teachers often demonstrate a fresh ability to apply their skills and mathematical knowledge in teaching. They may be uncertain about their abilities to serve in a teaching role. This phenomenon was getting attention among researchers. They revealed that preservice mathematics teachers failed to promise handling mathematics teaching to all levels of classroom teaching (Hine & Thai, 2019) and highlighting the importance of basic preparation in addition to personal factors (Twhill et al., 2023). To observe their teaching preparedness closely, discovering factors influencing it is necessary. Since mathematics involves complex thinking processes, properly identifying the factors that influence teaching preparedness may encourage authorities to assist teachers

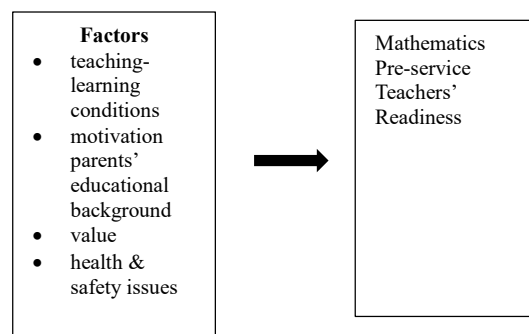
Moreover, no matter how comprehensive pre-service teacher preparation is, it cannot guarantee that pre-service teachers will be able to handle every challenge they encounter in their career development (OECD, 2019a, 2019b). It is believed that, despite effective pre-service preparation, there are always aspects where it falls short (Friday, 2016). It is challenging to assess the level of preparation, as it is influenced by a range of internal and external factors. While previous research has explored pre-service teachers' preparation, it often focuses on documenting the current state of readiness rather than investigating the underlying variables that contribute to or hinder it since the beginning stages of their teaching careers. Particularly, Maslow's (Maslow, 1987) views on basic needs effectively explain the progression that begins with an individual's physical and mental well-being. It is important to look at mental health from the perspective of an individual's motivation. The demands of their employment motivate pre-service teachers to acquire a wide range of skills beyond cognitive abilities. This includes actively participating in classroom communication and fostering connections with colleagues. Self-determination (Deci & Ryan, 1985) and social cognitive theory (Bandura, 1977) offer useful direction to teachers in improving their self-efficacy, advancing their careers, and seeking support through social interaction. By keeping the well-being of pre-service teachers in mind, promising healthy and safe environments in promoting appreciation of valuing outcomes of teaching and learning, as well as motivating them to proceed with professional development. Despite their efforts, pre-service teachers require additional support and guidance to further their professional knowledge development (Tatira, 2023).

Conceptual framework

Figure 1 illustrates the conceptual framework of this study, which focuses on the basic efforts of pre-service teachers to understand their responsibilities within the current teaching-learning conditions, commit to their own well-being when accepting offers, and ensure the presence of teaching values; these elements provide opportunities for further investigation into how they influence the teachers' readiness for teaching.

Figure 1

The Contributing Factors to Pre-service Teachers' Readiness



Their responsibilities are based on fulfilling basic needs necessary for carrying out educational activities, as further described in Maslow's (Maslow, 1987) principles on essential requirements for daily academic progression. Hence, teachers should be aware of their positive mental and physical health. Such approaches create opportunities to incorporate values that enhance academic development and promote well-being in the learning process. Furthermore, values on appreciation of parents' background encourage their effort to actively participate in classroom communication and foster connections and progress in the teaching and learning, which is full of challenges (Bandura, 1977; Deci & Ryan, 1985).

Research objectives

Based on the understanding in the conceptual framework, the focus is on assessing teachers' readiness and identifying the factors that justify the need for current professional development among pre-service teachers. Hence, this study aims to establish the following objectives:

1. To identify the level of readiness for teaching mathematics among pre-service teachers.
2. To identify pre-service teachers' perceptions of contributing factors (teaching-learning conditions, pre-service teachers' motivation, parents' educational background, pre-service teachers' values, and health and safety issues) to their readiness for teaching mathematics.
3. To determine the correlation between the contributing factors and the readiness of teaching mathematics among pre-service teachers.
4. To investigate the relationship between the contributing factors and readiness of teaching mathematics among pre-service teachers.

Methodology

Research design

This study employed a quantitative approach to gather data using a questionnaire. Specifically, this study used a correlational research design to investigate the correlation between the identified factors and perceived readiness. The questionnaires were adapted from previous studies (Manasia et al., 2019; Tetteh & Agyei, 2022). The overall reliability was tested at $\alpha = .92$, for which the internal consistencies were established. Table 1 displays a sample of items from the 39 items to gauge pre-service teachers' readiness in the four dimensions as aimed in the first research objective

Respondents of the study

The data collection involved 118 mathematics education students from a public university in Malaysia. The participants had been undergoing a teaching practicum that included both microteaching classes and a school practicum.

Instruments

Table 1 displays a sample of items to gauge pre-service teachers' readiness as presented in the first research objective (RO1). The questionnaire consists of 39 items, measuring the dimensions of professional knowledge, professional practices, professional engagement, and self-management.

Table 1

Sample of Items to Gauge Pre-Service Teachers' Readiness

Dimension	Sample item
Professional knowledge (9 items)	Item 1: I know the scientific content of the discipline taught
	Item 2 I know which instructional strategies to use in my learning in order to achieve cognitive goals and to boost critical thinking, problem solving, complex situation analysis, and decision-making.
Professional practices (13 items)	Item 1 Plan the teaching process based on the curricular documents

continued

Professional engagement (10 items)	Item 2 Design the teaching activities, taking into account the age particularities of the students and how they can influence the learning
	Item 1 Identify my own training needs
Self-management (7 items)	Item 2 Establish a professional development plan to cover the identified learning needs
	Item 1 Create a well-being atmosphere at school/in the activities
	Item 2 Effectively manage one's own activities (planning, organization, responsibilities, etc.).

Table 2 displays a sample of items to gauge the contributing factors towards pre-service teachers' readiness as presented in the second research objective (RO2), examining pre-service teachers' perceptions of contributing factors. The questionnaire consists of 23 items, measuring teaching and learning conditions, teacher motivation, parents' educational background, teacher valuing, and health and safety concerns.

Table 2

Sample of Items to Gauge the Contributing Factors towards Pre-Service Teachers' Readiness

Dimension	Sample item
Teaching and learning conditions,	Item 1 The classroom in school meets my mathematics teaching needs
	Item 2 Classroom conditions are very favourable for teaching and learning mathematics
Teacher motivation	Item 1 Given the chance, I would like to pursue mathematics related courses in the future
	Item 2 I would have chosen to take mathematics even if it were not made a compulsory subject.
Parents' educational background	Item 1 My father/male guardian's highest qualification (no formal education, primary school, secondary school, a diploma, a degree/a master's degree/ PhD).
	Item 2 My mother' highest level of education (no formal education, primary school, secondary school, a diploma, a degree/a master's degree/ PhD).
Teacher valuing	Item 1 Mathematics will help improve my thinking capacity.
	Item 2 I am aware that mathematics will help me earn a living
Health and safety concerns.	Item 1 School has a strong security system that ensures that everybody is safe
	Item 2 The school provide quality help on my teaching

Findings and discussions

The data were examined in relation to the research objectives outlined for each finding.

Finding 1: the readiness of teaching mathematics

The researchers assessed the pre-service teachers' assessments of their readiness for teaching mathematics. The result was intended to achieve the first research objective.

Table 3 displays the level of readiness of pre-service teachers in teaching mathematics. The investigation revealed that the readiness level of pre-service teachers was high, with a mean value of 4.0748 and a standard deviation of 0.3101.

Table 3

Descriptive Analysis of The Level of Readiness of Teaching Mathematics among Pre-Service Teachers

Dimension	Mean	Standard Deviation
Professional knowledge	3.9605	0.3613
Professional practice	4.0652	0.3479
Professional engagement	4.1042	0.3334
Self-management	4.1695	0.3735
Total	4.0748	0.3101

Note. Adopted from Pre-Service Teacher Preparedness for Fostering Education for Sustainable Development: An Empirical Analysis of Central Dimensions of Teaching Readiness, by Manasia et al. (2019).

The perceived readiness in terms of specific dimensions was examined by defining their levels based on ascending mean ratings. The dimensions "self-management", "professional engagement", and "professional practice" received higher ratings compared to other variables, with means of 4.169 (standard deviation = 0.3735), 4.1042 (standard deviation = 0.3334), and 4.0652 (standard deviation = 0.3479), respectively. The rating for "professional knowledge" was lower than the others, with a mean 3.9605 (standard deviation = 0.3613).

Finding 2: The contributing factors

The pre-service teachers' perceptions of the contributing factors were measured. The outcome was intended to achieve the second research objective.

The result shown in Table 4 represents the level of the contributing factors as perceived by the pre-service teachers. The analysis showed that the overall level of contributing factors among the pre-service teachers was moderately high, with a mean 3.9832 and a standard deviation of 0.3097.

Table 4

Descriptive Analysis of Pre-Service Teachers' Perception on Contributing Factors to Readiness of Teaching Mathematics

Factor	Mean	Standard deviation
Teaching-learning conditions	3.7530	0.4889
Pre-service teachers' motivation	4.0233	0.4725
Parents' educational background	4.2479	0.4243
Pre-service teachers' valuing	3.9809	0.4472
Health and safety issues	3.9910	0.4697
Total	3.9832	0.3097

The perceived contributing factors were examined by defining their levels based on ascending mean ratings. The variables "parents' educational background" and "pre-service teachers' motivation" received higher ratings compared to other variables, with means of 4.2479 (standard deviation = 0.4243) and 4.0233 (standard deviation = 0.4725), respectively. The ratings were ranked in the following order: "health and safety issues" (mean = 3.9910,

standard deviation = 0.4697); "pre-service teachers' valuing" (mean = 3.9809, standard deviation = 0.4472); and "teaching-learning conditions" (mean = 3.7530, standard deviation = 0.4889).

Finding 3: The correlations

A correlation analysis was conducted to achieve the third research objective.

The result of the analysis of Pearson Product-Moment Correlation as shown in Table 5 revealed that the coefficient correlation between level of readiness and the factor in overall (teaching-learning conditions, pre-service teachers' motivation, parents' educational background, pre-service teachers' valuing, health and safety issues) is 0.674 with $p < 0.05$. Hence, there is strong evidence to reject the hypothesis. It was concluded that there is a moderate positive correlation between readiness and the factor overall.

Table 5

Correlation Table of The Correlation Between the Contributing Factors and Readiness of Teaching Mathematics Among Pre-Service Teachers

Factor	Pearson Correlation of readiness, <i>r</i> <ul style="list-style-type: none"> ● Professional knowledge ● Professional practice ● Professional engagement ● Self-management 	Sig. level, <i>p</i>	Result
Teaching-learning conditions	0.330	0.000	Weak correlation
Pre-service teachers' motivation	0.502	0.000	Moderate correlation
Parents' educational background	0.364	0.000	Weak correlation
Pre-service teachers' valuing	0.584	0.000	Moderate correlation
Health and safety issues	0.489	0.000	Moderate correlation
Total	0.674	0.000	Moderate correlation

Table 5 also presents the further results of the specific factors. Based on the table above, it was shown that there existed a low positive correlation between the level of readiness and teaching-learning conditions ($r = .330, p < .001$). Similarly, the result showed that there were moderate positive correlations between the level of readiness and (1) Pre-service Teachers' Valuing, with a Pearson correlation value of ($r = .584, p < .05$); (2) Pre-service teachers' motivation, with a Pearson correlation value of ($r = .502, p < 0.05$); (3) Health and Safety Issues, with a Pearson correlation value of ($r = .489, p < 0.05$). Since both p-values for teaching-learning conditions and pre-service teachers' motivation were less than 0.05, thus, reject the null hypothesis. Thus, there was enough evidence to conclude that the factors (teaching-learning conditions and pre-service teachers' motivation) and level of readiness were correlated.

Hence, among the factors, only three factors (pre-service teachers' motivation, pre-service teachers' valuing, and health and safety issues) showed a moderate positive correlation with the level of readiness. Meanwhile, teaching-learning conditions and parents' educational background dimensions exhibited a low positive correlation with the level of readiness. Thus, the factors as overall (teaching-learning conditions, pre-service teachers' motivation, parents' educational background, pre-service teachers' valuing, and health and safety issues) and the level of readiness were statistically significantly correlated, with ($r = .674, p < .001$).

Finding IV: Regression analysis

A regression analysis was conducted to achieve the fourth research objective.

The two factors on teaching-learning conditions and parents' educational backgrounds did not show convincing correlations to readiness. In addition, these two factors did not significantly contribute to readiness in the

regression analysis which involved in the analysis of all the factors. Hence, in the final model of regression analysis, the three significant factors with moderate correlations were included as predictors while the response variable was readiness to teach mathematics.

The results showed there exists a significant relationship between readiness and the factors to teach mathematics. The result of ANOVA in Table 6 shows the model is significant with $F=34.171$ with $p < 0.05$. There is sufficient evidence to conclude that there is a relationship between readiness and the three factors.

Table 6

ANOVA^a

Model		Sum of squares	DF	Mean square	F	Sig.
1	Regression	5.325	3	1.775	34.171	0.000 ^b
	Residual	5.922	114	0.052		
	Total	11.247	117			

Besides, the result (Table 7) shows 47.3% of the variation in readiness could be explained by the three contributing factors (Pre-service Teachers' Motivation, Pre-service Teachers' Valuing and Health and Safety Issues).

Table 7.

Regression Analysis Summary for Significant Factors Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.688 ^a	0.473	0.460	0.22792

Based on the output from Table 8, the results show that three independent variables (pre-service teachers' motivation, pre-service teachers' valuing and health and safety issues) significantly influenced readiness. The results indicated that all 47.3% of the variation in readiness was explained by the three factors.

Table 8

Summarization of The Regression Analysis for Significant Factors

Variable	B	SE B	β	t	p
(Constant)	1.689	0.238		7.103	.000
Pre-service teachers' motivation	0.191	0.049	0.292	3.898	.000
Pre-service teachers' valuing	0.242	0.056	0.349	3.304	.000
Health and safety issues	0.167	0.051	0.253	3.290	.001

Note. $R^2=0.473$, Adjusted $R^2 = 0.460$, $F(3,114) = 34.171$, $p < 0.001$

B=Unstandardized coefficients; SE B=standard errors; β =standardized coefficients; t-values, and p-values.

The results of the Multiple Linear Regression Test analysis reveal significant relationships between readiness and contributing factors which were pre-service teachers' motivation, pre-service teachers' valuing, and health and safety issues are significant predictors of readiness, with p-values of 0.000, 0.000, and 0.001, respectively. For these factors, the null hypothesis, H_0 was rejected, indicating strong evidence of their impact on readiness to teach mathematics.

In summary, the analysis concludes that motivation, valuing of teaching, and health and safety issues are significant predictors of pre-service teachers' readiness meanwhile teaching-learning conditions and parents' educational background do not have a significant impact. Enhancing these factors could potentially improve readiness among pre-service teachers, thereby contributing to their success and effectiveness in the teaching profession. These findings underscore the importance of fostering motivation, ensuring that teaching is highly valued, and maintaining good health and safety conditions in educational settings to better prepare pre-service teachers for their future careers.

In this study, the pre-service teachers' knowledge was assessed. They demonstrated, on average, an above-average level of knowledge in practice, engagement, and self-management compared to professional knowledge. Nevertheless, this study found that the pre-service teachers had the lowest ratings in professional knowledge, which was contrary to the outcomes shown by Manasia et al. (2020). In this context, it is important to note that Manasia's study was conducted before the pandemic, whereas this study was carried out after the pandemic. This indicates that there is a need to enhance professional knowledge to address the challenges. These results indicated that pre-service teachers were more prepared with practical knowledge than critical knowledge, requiring more effort in critical thinking. Observing teachers' knowledge aligns with current needs to produce quality teachers, echoing the current research done by Manasia et al. (2020). It also reflects the need to equip teachers with self-awareness of their own knowledge in various aspects of pedagogy, pedagogical content knowledge, subject matter, and educational contexts (Tatira, 2023). In this study, pre-service teachers acquired their readiness through university courses and practices; however, they typically required additional efforts and opportunities for professional knowledge development, including STEM knowledge, mathematical thinking, and problem-solving skills (Teoh, et al., 2022; Teoh & et al., 2024). In the technology digital transformation era, pre-service teachers are urged to prepare themselves for STEM education or 21st century teaching and learning development. It is common for pre-service teachers to be prepared with teaching practices, but they may need to add specific relevant knowledge, as their professional knowledge in terms of practices, engagement, and self-management may be slightly lacking. During their teaching practicum, pre-service teachers primarily demonstrate their pedagogical knowledge. However, they must possess additional professional knowledge to effectively implement lessons that integrate HOTS knowledge, which is a fundamental method of instilling 21st century skills in students (Tatira, 2023). It's crucial to observe their academic skills in conducting HOTS separately from their pedagogical knowledge, as it significantly impacts their ability to provide HOTS instruction. Hence, to produce good-quality teachers, more effort needs to be put into harnessing their abilities to develop some relevant professional knowledge and skills, such as critical thinking skills, in teaching mathematics and professional development on STEM skills (Ventista & Brown, 2023).

On the other hand, the specific factors that influenced the development of pre-service teachers' readiness have shown that three main factors, namely motivation, pre-service teachers' value, motivation, and health and safety, were contributing to their readiness in their professional development in teaching and learning. These findings align with the above results, suggesting that pre-service teachers, lacking in professional knowledge, require increased motivation and valuable opportunities to teach mathematics while maintaining good health. Therefore, it is crucial for pre-service teachers to gain motivation and experience in enhancing their professional knowledge, even if they are already equipped with practical experience and engagement. Maintaining their health is another crucial aspect of equipping pre-service teachers with the necessary professional competencies. Teachers who are facing diverse challenges may need to maintain their occupational wellbeing. A good health and safety environment is the only way to achieve this (Nwoko et al., 2023). Therefore, creating a positive and cheerful work environment aligns with the goal of fostering positive emotions among teachers. Teachers bear the significant responsibility of staying up-to-date with the latest knowledge, monitoring student performance, and enhancing student achievement. This study found that teachers may need to motivate themselves by providing valuable daily values of their teaching and keeping all positive to remain engaged as measured in readiness. Previous research validated this, suggesting that teachers of mathematics should monitor their stress-inducing behavior and cognitive engagement (Jian et al., 2022).

Conclusion and recommendation

This study has successfully identified key factors that contribute to the preparation of pre-service mathematics teachers for their teaching careers. The focus involves their condition that they will face while teaching, the motivation they gained in teaching, parents' educational background, how they value their teaching profession, and health and safety issues. Among these, pre-service teachers' valuing and motivation emerged as the most critical predictors, highlighting the need for personal and institutional efforts to foster motivation. Health and safety concerns and parental education also play significant roles. These insights suggest the importance of targeted programs to enhance readiness, urging stakeholders to implement effective measures that can significantly improve mathematics education for pre-service teachers.

Conflict of interest

The authors declare no conflicts of interest

Author contribution

The authors affirmed that there is no conflict of interest in this article. Puteri Nurul Husna Che Hassan: Data collection, Data curation. Teoh Sian Hoon: Conceptualization, Writing - Original draft preparation, Leading. Parmjit Singh: Proofread. Surya Sari Faradiba: Writing - Reviewed and Editing.

Data availability statement

Data will be made available on request.

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