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Evidence of the need for developing an integrated model of mathematics teachers' readiness as agents of change

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Abstract

This study aims to identify the need to develop an integrated model of the readiness of mathematics teachers as agents of change. Teachers' readiness is crucial for the effectiveness of the teaching process and the enhancement of pedagogical innovation. This study employs a qualitative methodology. A semi-structured interview was conducted with 14 study participants to ensure that the proposed model fits the demands of users. This includes education and teaching experts from Malaysia's southern and central regions. The interview data were transcribed and analyzed thematically using ATLAS.ti24 software. Results indicate a need to develop an integrated model of mathematics teachers' readiness as agents of change. All study participants emphasized the significance of addressing mathematics teacher readiness. Three main themes have been identified: (1) pedagogical needs, (2) strengthening mathematics teacher competence and (3) the configuration model as a guideline and checklist. The findings emphasize the importance of addressing mathematics teachers' readiness. An integrated model based on professional knowledge and pedagogical skills was proposed to support teachers in acting as agents of change. This study provides valuable insights for mathematics teachers and stakeholders. The findings indicate directions for future research particularly in the systematic development and design of the proposed integrated model which aims to enhance teacher readiness and pedagogical innovation.

Keywords: Agents of change, Integrated model, Mathematics teacher readiness, Professional knowledge, Pedagogical skills, Teaching.

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Contents

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Contribution of this paper to the literature
This study proposes an integrated model of mathematics teacher readiness based on professional knowledge and pedagogical skills. This study can improve teacher quality and fill gaps in existing educational research by offering a new framework for understanding and enhancing the role of mathematics teachers as agents of change.

1. Introduction

Educational transformation is a comprehensive process that involves a shift away from traditional teaching and learning techniques and towards a more innovative, flexible and learner-centered approach. This progress is driven by the need to meet the changing needs of the twenty-first century where critical thinking, creativity and digital literacy have become important abilities (Biberman-Shalev, 2021). Technology in education influences the educational environment by becoming an essential component rather than just a tool for teaching and learning (Inandi & Giliç, 2016). It encourages personalized learning which customizes the content and pace of instruction to best fit the needs of the student resulting in increased student engagement and efficacy (Galanti & Holincheck, 2022; Sutherland, 2021).

Additionally, the teacher's role changes from only imparting knowledge to supporting students by promoting inquiry-based learning and fostering curiosity (Guerreiro, 2017). A shift of this magnitude needs significant changes in curriculum structure, teaching approaches as well as assessment practices to become application-oriented and contextually linked. The education system attempts to foster this strategy by creating a learning scenario to prepare students for future academic targets and generalized lifelong learning (Rodríguez-Muñiz, Burón, Aguilar-González, & Muñiz-Rodríguez, 2021).The most noticeable is the significant gaps in problems related to the system's readiness for reform which contradicts the previous work's increased focus on educational change readiness (Wang, Olivier, & Chen, 2023). Teacher attitudes are an important aspect of change readiness; thus, addressing them is necessary to bridge the gap.

Many investigations have been carried out on the readiness of Malaysian mathematics teachers (Amirah, Mohd Jasmy, Siti Adilah, Noraina Ayu, & Norkamaliah, 2018; Nabilah Aida & Roslinda, 2023). Nonetheless, the majority of them emphasize the implementation of Science, Technology, Engineering and Mathematics (STEM) education (Abdul Halim et al., 2017; Nur Fatahiyah & Siti Nur Diyana, 2020). Previous studies indicated that teaching specific mathematic subjects (Ab Aziz & Maat, 2021) as well as using technological resources (Junit, Abd Halim, & Saidin, 2023) seem to be more crucial than developing comprehensive frameworks and models for math teachers (Demir & Qureshi, 2019; Malva, Leijen, & Baucal, 2020). A comprehensive strategy is necessary to understand and improve maths teachers' readiness to act as change agents in the context of this gap. The research is also important because a comprehensive model can be developed that can tackle pedagogical skills as well as professional knowledge in mathematics teachers. It matches with the worldwide educational standards. This study will help fill this gap as well as provide useful insights to systematically prepare teachers and important practical guidance for mathematics teachers, policymakers and curriculum developers to enhance teaching practices and student achievement.

This particular work is established to answer the following research questions: What is the need for developing an integrated model of mathematics teachers' readiness as agents of change?

2. Literature Review

2.1. Change Theory and School Improvement

The concept of education suggests that teachers are the change agents who can alter the educational landscape. Indeed, Fullan and Thiers (2017) highlight the absence of a learning profession in education with teachers often lacking sufficient subject matter knowledge, the means to prove teaching is effective and how to influence their surroundings. He stresses the need to clarify and raise the status of teachers' moral purpose and change agency to transform the profession. Fullan (2007) revisits the historical proposition that teachers were moral change agents and why the theory has not been embraced. He argues for understanding how moral purpose and change agency drive teacher education reform. Fullan (2007) work highlights that teachers need ongoing learning and development to genuinely transform schools. He provides guidance for using change to enhance teacher education programs as well as school procedures (Fullan, 1982). Fullan (1994) stresses the importance for teachers to build a solid foundation of professionalism in analyzing teacher collaboration and collective involvement in educational change. He explains the necessity of leadership in overseeing the transition and ensuring that the revolution in teaching practices does not disperse. Additionally, Fullan (2005) goes into the problems with the reform process in education to the same extent as fragmented initiatives at the teacher and school levels. A shift from practices of professional development outside the school to the transformation of the professional culture of teaching based on collaborative professional development within the school must be highlighted. Fullan's (1983) research has underscored the necessity to use specific techniques and leadership skills through the effective change process especially in situations where there may be very serious disagreements that can get in the way of progress. In addition, Fullan's work emphasizes the significance of people in the role of developing or changing educational policies especially the vital roles that teachers play in participating as change agents.

2.2. Mathematics Teachers' Readiness

The mathematics teachers' readiness is crucial when considering educational reform and the incorporation of technology to teach. Findings from past studies have similarly illustrated the extent to which teachers' willingness to change is shaped by some factors. This could be their attitudes towards online teaching, their expectations of colleagues, how they cope with unexpected challenges, their knowledge as well as their limited time (Fujita et al., 2023). These dimensions should be highlighted to comprehend the cognitive, emotional and behavioral parts of readiness among teachers (Papagiannopoulou, Vaiopoulou, & Stamovlasis, 2023).

In addition, the readiness of mathematics teachers to overcome conventional teaching methods is important to meet the needs of students by adapting to changing conditions, technology and appropriate mathematical

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applications (Zulnaidi, Mafarja, Rahim, & Salleh, 2024). Nowadays, the teaching process needs to shift to more innovative methods. Therefore, teachers need to be prepared to apply innovative teaching methods (Siti Noor, Shamsuddin, Mohd Norakmar, & Shanmugam, 2022) such as a mathematics-based computer or internet resources, PowerPoint presentations and mathematical software. Support system requirements such as training and professional development can increase teachers' ability to diversify their pedagogical practices (Fathurrohman, Nindiasari, Anriani, & Pamungkas, 2021). However, programs that are carried out are still insufficient not only for novice teachers but also for teachers who are currently in service.

The lack of resources and support for teachers was also discussed by previous researchers (Kelley, Knowles, Holland, & Han, 2020). These resources consist of formal mechanisms and guidelines such as model development or frameworks (Chen, Geesa, Izci, & Song, 2021). The majority of existing studies are more descriptive in nature and provide little detail on mathematics teachers' readiness as change agents. Hence, it is important to develop an integrated model of mathematics teachers' readiness as change agents to benefit the educational practice and ensure the efficacy of training implementation. A better understanding of the readiness elements found in the literature will enable the development of specific interventions and professional development programs that focus on various aspects of teacher preparation ultimately leading to improved achievement in mathematics education.

2.3. Need Analysis

The needs analysis phase has significant importance in research as it consistently reveals the gap between reality and the ideal state. We use this approach to ensure the utility and effectiveness of research and interventions. Mckillip (1987) suggests that need analysis is a means to an end in decision-making about education and human services. It means identifying what is unique about the challenges faced by some groups in the past to design appropriate remedies. For instance, Mohd Paris and Saedah (2016) conducted a need analysis to investigate why students found history subjects boring. As a result, they developed plans to raise student interest and participation. Needs are analyzed thoroughly in educational research so that system models and interventions can result in more effective solutions that are required. Azli (2018) also highlighted how significant needs analysis is and the ways it plays a big role in deciding whether to develop model activities or not but also to ascertain that they are in line with the real needs of the target group. This stage permits a comprehensive insight into the requirements which leads to the designs and content creation of the educational models. Meanwhile, Muhammad Nidzam, Nurahimah, Syed Khalid, Julinamary, and Suhaila (2021) highlighted that in model development research, the analysis contributes to an in-depth understanding of the context and environment being considered and provides the basis for subsequent research phases. This ensures that the models generated are tailored to the context and are made to the exact needs of the population.

The use of the need analysis process guarantees that the results of the research are novel and practical. Furthermore, Mohd Amir Izuddin, Zuraina, and Azwin Arif (2022) employed a design and development research (DDR) methodology designed to establish new procedures, techniques as well as tools accordingly. It is not just a test of theoretical frameworks. It also assures their practicality which guarantees the accuracy of the research as well as its applicability in real-life scenarios. Researchers can bridge the gap between research and practice by creating interventions that are both beneficial in practice and theoretically sound by paying attention to individual requirements.

3. Method

3.1. Research Design

This study used a qualitative approach to assess the integrated model in depth to understand its development needs. This is the advantage of an approach capable of the collection of in-depth data able to make discoveries of the context it seeks to understand (Bloomberg & Volpe, 2019; Merriam & Tisdell, 2016). Some initial ideas about the design and development process of the integrated model are also outlined based on this feedback. Consequently, the data collection employs 14 study participants as experts by using in-depth interviews. A group of expert panels was consulted in an exploration of the components required to construct an integrated model of the mathematics teachers' readiness to be change agents.

3.2. Research Participants

The sample frame involves using a purposive sampling approach where participants will be selected about unique criteria and considerations for the justification of information to develop an integrated model (Rahman, 2023).

Table 1. The demographics of the study participants.

Participant identifier (P) number	Gender	Positions	Field of expertise	Interview duration (minutes)
P1	Female	MOE official	Instructional	120
P2	Female	MOE official	Mathematics education	120
P3	Female	MOE official	Instructional	120
P4	Female	Expert's teachers	Mathematics education	120
P5	Female	Expert's teachers	Mathematics education	120
P6	Female	SISC+	Mathematics education	120
P7	Female	MOE official	Mathematics education	120
P8	Female	Expert's teachers	Mathematics education	120
P9	Female	SISC+	Mathematics education	120
P10	Male	Expert's teachers	Mathematics education	120
P11	Male	Expert's teachers	Mathematics education	120
P12	Female	Expert's teachers	Mathematics education	120
P13	Female	Expert's teachers	Mathematics education	120
P14	Female	SISC+	Mathematics education	120

Note: Total of study participants, N = 14.

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Those participants were selected due to certain specifications. For instance, they are knowledgeable about the research context, have extensive experience as well as are experts in mathematics and teaching which aligns with the complex and specialized nature of the study. For these reasons, the participants were a selective sample of 14 individuals which included mathematics expert teachers, school improvement specialist coaches (SISC+) as well as Ministry of Education (MOE) officials. These numbers are corroborated by the views expressed by Guest, Bunce, and Johnson (2006) and Guest, Namey, and Chen (2020) who emphasize that 6–12 participants are often enough to reach saturation in qualitative research. This study contains the data of participants living in the southern and central regions of Malaysia. Table 1 displays the demographics of the study's participants.

3.3. Instrument

In-depth interviews are systematic activities meant to explore things further (Adu, 2019; Merriam & Tisdell, 2016). Interviewing helps the authors get a deeper insight into how individuals or groups of people feel, think and act towards their experiences and situations (Rowland, Dounas-Frazer, Ríos, Lewandowski, & Corwin, 2019). This approach gives the authors data appropriate to a real-world context. Interviews can also be face-to-face (Aydin-Gunbatar, Ekiz-Kiran, & Oztay, 2020; Gedamu & Shewangizaw, 2020; Nurul Izzati, Harun, & Mohd Khalid, 2021) or online (Chia, Ghavifekr, & Razak, 2020; Mason et al., 2021; Michel et al., 2021). Both mediums were chosen in this particular research.

Semi-structured interviews are essential in qualitative research such as in educational settings where in-depth interpretation of the experience of individuals is vital (Han & Ellis, 2019). Authors get rich and nuanced insights through in-depth descriptions of participant experiences by using a fixed set of questions while remaining open to new information (Hui, 2022). This approach enables comprehensive follow-up on participant responses. It provides a framework for gathering detailed and descriptive data that describes the specifics of the processes and mechanisms that underpin how individuals interpret events. These descriptions are important for the development of a comprehensive model of mathematics teachers' readiness as change agents and for a more nuanced view of their experiences as well as their willingness to be transformative in nature.

Laumann (2020) included an interview protocol with the purpose of helping the author test whether the interviews conducted met the research objectives. The author identified challenges and problems that were associated with the study setting using the literature review and the author's own experience (Taylor, Bogdan, & DeVault, 2016). This led to the formulation of interview questions which were used to determine the necessity of an inclusive model as per the 1987 discrepancy model. The interview protocol has been presented in two sections to comprehend the needs and necessity of developing this integrated model (see Table 2). The interview protocol was reviewed by two experts in validity processes for assurance of language appropriateness and alignment of questions with the aims of the study.

3.4. Research Procedures

The author performed a pilot study with two participants after formulating the interview. The author also performed a pilot study which allowed modifications in the questions before an actual study was conducted (Aziz & Khan, 2020). The questions need to be clear and pertinent to the topic of the research. Additionally, pilot studies provide an opportunity for authors to practice their communication skills (Malmqvist, Hellberg, Möllås, Rose, & Shevlin, 2019). It is crucial to have an active interaction session between the researcher and the participants.

Ethical approval and permission to carry out the study was granted by the policy planning and research division of the Ministry of Education Malaysia before the study. The author then contacted the study participants and organized the interview sessions after approval was obtained. The author arranged the scheduled time for the interview and prepared the audio equipment as well as any related documents. Furthermore, the author obtained permission and consent from all study respondents before the interview session.

Interviews were conducted by the first author with study participants at predetermined times and locations. The researcher self-introduced herself to the participants and explained the purpose of the study. For researchers, these natural settings and building rapport with research respondents are crucial (Hamilton & Finley, 2020; Liu, 2016). A session starts with a self-introduction as to their background, academic qualification, length of service as well as their contribution to the existing field. It was followed by questions asked one at a time to the respondents and accompanying follow-up and probing questions asked to elicit more details and depth. All interviews were audio recorded and lasted up to 120 minutes. Field notes were made after the interviews to improve the transcription accuracy and revise as required.

3.5. Data Analysis

Qualitative data analysis is an analytical process of interpreting as well as giving meaning to the data. The data is categorized into suitable categories and themes and then interpreted (Raskind et al., 2019). In this way, we are collecting the data simultaneously and analyzing the data to make sure that the gathered data can address the research questions and lead to improvement which will increase the comprehension of the researcher (Hemphill & Richards, 2018). Once the interview is done, the audio is transcribed and after that, the researcher examines it for accuracy (Lawrie, Schultz, Bailey, & Dargaville, 2019). Transcriptions were also verified by study participants first before being analyzed, classified and coded (FitzPatrick, 2019).

According to Creswell and Poth (2018), there are three main steps implemented in this study. The first is the collection and organization of interview data. Data organization and the data analysis process are done using ATLAS.ti software version 24. The advantage of using software when analyzing data is that it can save time and reduce paper usage (Zairul, 2019). This enables the avoidance of errors and research biases. The researcher also listened back to the audio recording and focused on the feedback given by the study participants.

The second step involves identifying and analyzing the data thematically. The researcher initiates the coding process after comprehending and organizing all the information. The coding process involves inductive and deductive approaches. Interview transcriptions were examined and analyzed line-by-line to identify meaningful sentence units. All sentence units are grouped under specific codes and categorized under sub-themes and main

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themes. This process occurs until the obtained data reaches saturation (Nelson, 2017). A saturation level is a situation when no new data appears and only repetition occurs (Ando, Cousins, & Young, 2014).

The last step involves interpreting the data and preparing a report of the findings. After finalizing the research data, report the findings through quotations and essays. Quotations, tables and diagrams are used to facilitate the reporting of findings. The presented narrative must be clear and interesting and research findings can be presented in narrative or descriptive form (Leavy, 2017). Overall, the data analysis of this study was carried out systematically covering the management of study data, the production of initial codes and main themes, the presentation of data and the interpretation of the study's findings.

3.6. Validity and Reliability

This study uses several validity and reliability strategies to increase the accuracy, consistency and credibility of the study findings. Among the strategies used are pilot studies, peer review, audit trails and repetition of questions during interview sessions (Hayashi, Abib, Hoppen, & Wolff, 2021). In contrast to the quantitative approach, aspects of validity and reliability occur simultaneously during data collection and analysis. We carry out these procedures to ensure that the research findings accurately and consistently reflect the context under investigation (Spiers, Morse, Olson, Mayan, & Barrett, 2018). In fact, in this study, the organization's information and the study participants' backgrounds are confidential and protected (Rinne, Lundqvist, Johannsen, & Yildirim, 2023). Therefore, we use pseudonyms to represent the study participants involved in the data collection. In the next section, we will discuss the findings and answer the research questions.

4. Results

The study's findings are based on qualitative research specifically in-depth interviews with fourteen participants with substantial expertise and knowledge in mathematics and instruction. This section begins with an overview of the study participants. It was then followed by results on the need for an integrated model. We employ acronyms to protect the identities of those participating in privacy. We represent each study participant by "P" followed by a number (for example, P01 refers to the first person). Topics and subthemes progressively structure the research findings, providing a clear and comprehensive overview of the model development requirements. This structured presentation helps to illustrate the specific necessities and insights received from participants ensuring a thorough understanding of the indicated needs. The demographic characteristics of the study participants are shown in Table 2.

Table 2. The demographic characteristics of study participants (N=14).

Characteristics		Number (N=14)	Percentages (%)
Work experience in education	6 -10 years	2	14
	11 – 15 years	2	14
	16 – 20 years	6	44
	20 years and above	4	28
Gender	Male	2	14
	Female	12	86
Education level	Doctoral degree	2	14
	Master's degree	3	27
	Bachelor's degree	9	59
Expertise	Mathematics education	12	86
	Instructional	2	14

Table 2 shows that 12 of the study participants in this interview have more than ten years of educational experience. All of the participants have education-related skills particularly in mathematics and instruction. However, all study participants are from various institutions or schools including mathematics expert teachers, STEM experts, curriculum development experts, pedagogy experts and professional development specialists. According to the interview findings, there is a significant need in Malaysia to develop an integrated model of mathematics teachers' readiness as change agents. Participants in this study also provided suggestions and justifications for developing this integrated model. This finding identifies three main themes as listed in Table 3 identifying themes and sub-themes.

Table 3. Themes and sub-themes.

Themes	Subthemes
Pedagogical need	1. Insufficient exposure
	2. Limited understanding
	3. Conventional approach
Strengthening mathematics teacher competence	1. Personality competence
	2. Pedagogical competence
Model configuration	1. Guidance
	2. Checklists
	3. Graphics

4.1. Pedagogical Need

All study participants agreed that pedagogy is an essential component that must be prioritized. Under this theme, mathematics teachers face three challenges such as insufficient exposure, limited understanding and a conventional approach. Figure 1 displays the results of the pedagogical need themes.

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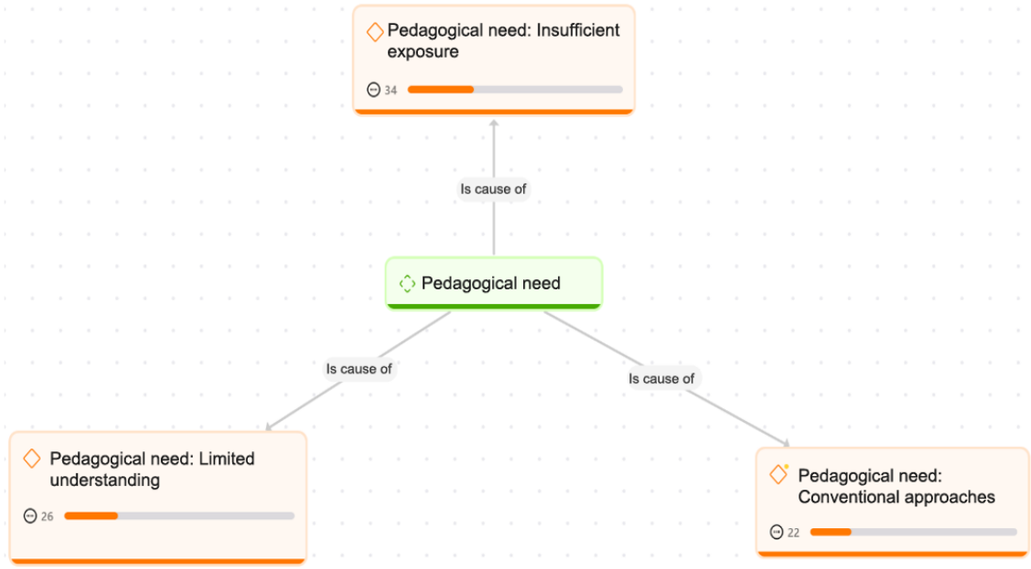

Figure 1. Network on the pedagogical need theme.

4.1.1. Insufficient Exposure

The first subtheme was "insufficient exposure". A total of 12 interviewees underlined that a lack of instructional experience will make it difficult for teachers to offer effective teaching sessions. In recent times, limited exposure to varied problem-solving approaches and real-world applications might impede students' understanding and motivation in the mathematics learning process. This insight highlights the need for mathematics teachers to be active in self-learning and use more contemporary teaching resources. Mathematics teachers who vary their teaching styles can create a more exciting learning environment and boost students' interest in the subject. For example, one interviewee said,

"*But for the new topics right now. For example, I experienced a big problem like the financial topic. I think most math teachers experience the same problem. We lack exposure to what needs to be emphasized in the topic* " (P08).

4.1.2. Limited Understanding

Limited understanding was seen as a serious worry by 86% of those participants. Mathematics teachers realize the need to ensure that students gain deep and extensive learning of the subject area. This issue indicates teachers' readiness to use more effective instructional methods such as differentiated teaching and specific techniques to meet the unique learning needs of their students. Mathematics teachers exhibit their dedication to assisting student learning and enhancing educational results by focusing on understanding. Their readiness to adapt and develop their teaching approaches demonstrates their position as change agents in the educational landscape. Several participants stated that

" *There are parts of the subtopic that are quite difficult to understand. However, we lack any visual or animation materials to aid in the teaching process* " (P07).

" *I also have to study. I need to complete the same exercises as the students. So we can convey it to the students* " (P12).

4.1.3. Conventional Approach

The last subtheme focuses on transforming education by reducing traditional ways. Ten study participants agree that traditional teaching methods should be replaced with student-centered approaches and strategies. For example, technology can be incorporated into the teaching and learning process in the classroom. Maths teachers must be prepared to combine traditional methods with modern approaches to create a more creative and meaningful learning environment. Several participants echoed this viewpoint.

" *This is still related to the teacher. This pertains specifically to teacher-centered teaching practices which still involve the use of chalk and talk* " (P03).

" *Teach with fun, you can do activities, right? I really think the students will have fun with math because he likes to teach chalk and talk, it's a bit difficult*" (P13).

4.2. Strengthening Mathematics Teacher Competence

The second theme that emerged from the interviews was " strengthening mathematics teachers competence". The results indicate that the competencies found are critical to raising the professionalism and readiness of mathematics teachers. The two primary subthemes of this competency are personality competence and pedagogical competence. Each of these subthemes is supported by feedback from study participants from various organizations, underscoring the significance of this attribute in the context of mathematical education. Figure 2 shows an overview of these themes.

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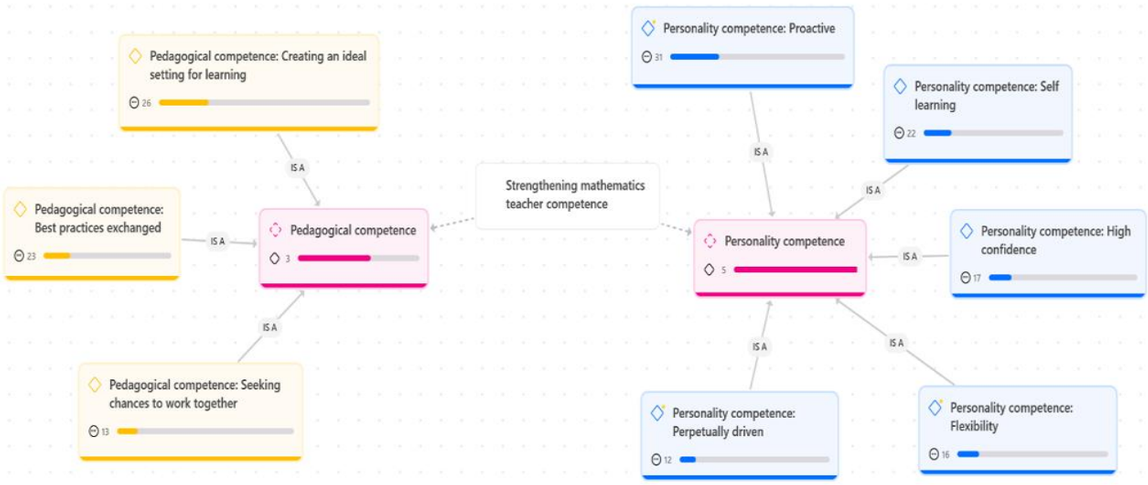

Figure 2. Network on the strengthening mathematics teacher competence theme.

4.2.1. Personality Competence

For mathematics teachers, personality competence is defined as the value of interpersonal abilities and personal qualities that must be present. Mathematics teachers with characteristics such as proactive, self-learning, high confidence, flexibility and perpetual drive can create a positive and conducive learning environment for their students. This subthemes focuses on the idea that to be a good teacher, you need to be able to build strong relationships with your students, keep the classroom under control and get students excited about learning. The quality of learning can be improved by teachers who have these personality traits because they can motivate and engage students. Teachers are role models for their students. Below are some excerpts from their perspective.

" *To me, how does the teacher prepare himself to teach? To improve his professionalism in the field of education, especially in the field of mathematics*" (P05).

" *So everybody will keep improving themselves and every year there will be evaluations. Students evaluate teachers and teachers need to improve their skills and knowledge* " (P02).

" *Even if we have experience, we have to always update our knowledge. This means that if we have a lot of teaching experience, we always have to keep up with the latest knowledge* " (P06).

4.2.2. Pedagogical Competence

The second is pedagogical competency. Most research participants stressed the need to have excellent teaching skills when teaching mathematics. Exchanging best practices, creating an ideal setting for learning and looking for chances for collaboration are all part of this subtheme. Interviewees often recommend that teachers exchange best practices which include sharing effective teaching techniques to improve teaching techniques. The creation of a friendly and well-structured classroom atmosphere that encourages student participation is the main emphasis of the need to design the perfect learning environment. Participants in the study also pointed out the benefits of looking for joint venture possibilities. Math teachers can improve their readiness to be change agents in mathematics education by cooperating and sharing resources. Their response to these subthemes was as follows:

" *Sharing can enhance high-order thinking skills (HOTS) that mathematics teachers have acquired. It can also enhance the teaching method by incorporating the latest pedagogical techniques* " (P01).

" *So, the more you work together to plan, the richer your source will be. So that's right, not only plan the lesson in the context of the school but also look at the best practices of the school in your area too* " (P03).

4.3. Model Configuration

The next subtheme describes the model configuration which includes a preliminary overview of the features of the developed integrated model. Study participants suggest the developed model should be characterized, act as a guideline checklist and have attractive graphics. Figure 3 presents the subthemes found in these responses.

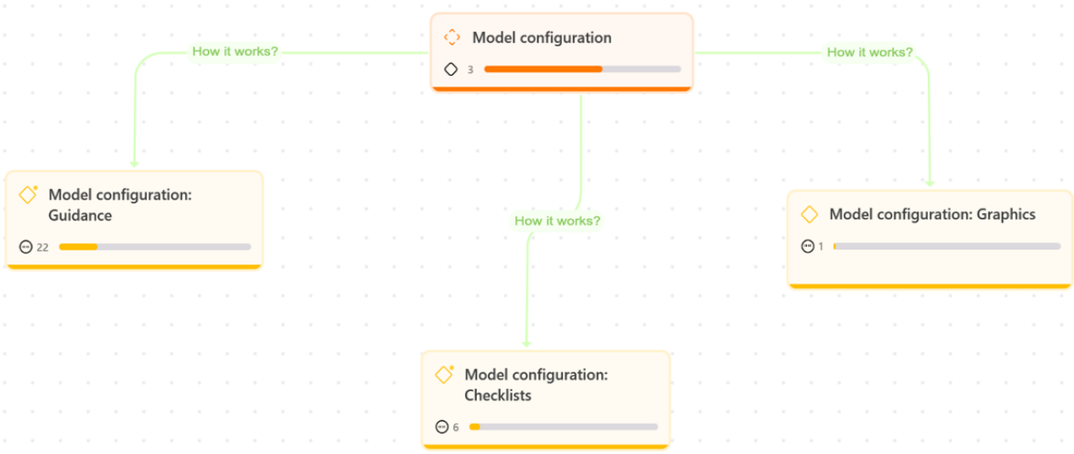

Figure 3. Network on the model configuration theme.

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A total of 10 study participants agreed that the developed integrated model can be used as a guideline. It is not limited to mathematics teachers only but can be used as a guide to stakeholders especially curriculum developers and teacher training providers. This can be seen through the following interview excerpt:

" *I believe that having such a model can serve as a guide for teachers to implement more in line with current curriculum requirements* " (P01).

" *So, for me, the teacher needs to have something. A model must be present to provide guidance to the teacher. This is necessary because not all teachers have the time to conduct their own research* " (P04).

P05, P09 and P11 agree that the developed model can also serve as a checklist. Mathematics teachers can self-evaluate and subsequently improve the quality of their teaching using the model developed. Their recommendations are

" *I think it is necessary. For instance, consider a scenario where we have a list or checklist. Once we have completed all the checklists will we be considered ready teachers* " (P05).

" *When there is a model, the teacher can create something based on that model that everyone wants to convey. However, he has only slightly modified the activities which could potentially enhance their effectiveness. But he needs a model* " (P09).

" *There needs to be a model. Otherwise, we will move aimlessly* " (P11).

In addition, P01 said that using attractive graphics, information and model details can be presented more easily and concisely.

" *People call it an infographic. Simple and manageable can be useful in their situation. So, I think it's very appropriate* " (P01).

4.4. The Need for the Development of an Integrated Model of the Readiness of Mathematics Teachers as Agents of Change

It is crucial to focus on the readiness of mathematics teachers as change agents to implement effective teaching and create a learning environment that supports student development. The findings of this study show that there is a high need to develop this integrated model. It not only deals with teaching aspects but also involves character building and teacher professionalism. All study participants agreed that this integrated model needed to be developed. The objective of this integrated approach is to enable practical and strategic interventions aimed at addressing the educational demands mentioned in the first theme. Teachers can use the proposed integrated model as support and reference material to enhance their responsiveness and adaptability to changes in the education system.

5. Discussion

This study indicates that there is a need to develop an integrated model of mathematics teachers' readiness as agents of change. According to the findings, three main themes support the development of this integrated model: pedagogical needs, strengthening mathematics teacher competence and model configuration. When there is a change in education, mathematics teachers need enough time to improve their understanding so that they can adapt to the changes. However, the findings indicate a persistent underrepresentation of mathematics teachers. The exposure to training and teaching programs received in the early stages of service is still insufficient. This problem is also seen to occur in several other developed countries (Bowden, Uwineza, Dushimimana, & Uworwabayeho, 2022; Chen et al., 2021; Lünne, Schnell, & Biehler, 2021). Continuous exposure to mathematics teachers is necessary encompassing current knowledge and skills.

According to the interview findings, the study participants stated that strengthening teacher competence will indirectly affect the readiness of mathematics teachers to act as agents of change. We found that a teacher's personality, perseverance and behaviour were essential elements in ensuring high-quality instruction which is in line with the findings of Siti Noor et al. (2022). Mathematics teachers with high competence are more confident and creative making the process of teaching mathematics interesting and meaningful. This finding supports the idea that giving more autonomy to teachers such as opportunities to explore the environment and variety in teaching mathematics can attract teachers' interest and enjoyment in teaching mathematics (Russo et al., 2021).

Our findings show a close relationship between professional knowledge and pedagogical skills as well as the readiness of mathematics teachers as change agents. This finding indicates that we should not only develop this model for novice teachers but also extend it to in-service teachers. This finding is contrary to previous studies which stated that experienced teachers have high mathematical beliefs. We discovered a close relationship between professional knowledge and pedagogical skills in addition to the mathematics teachers' readiness as change agents. These findings suggest that this model should not only be catered to novice teachers but also to existing in-service teachers. Experienced teachers hold strong mathematical beliefs contrary to earlier studies (Kohar, Wardani, & Fachrudin, 2019) because a mathematics teacher has been teaching for a longer period, it does not mean that the teacher has a vast amount of professional knowledge and skills. Knowledge and professional skills cannot be built solely with conferences and workshops, as they require constant support and input.

The mathematics teaching session may be completed and have meaning to it through the incorporation of professional knowledge as well as pedagogical skills. All study participants agreed and stated that it is important and necessary to develop an integrated model of mathematics teachers' readiness to act as agents of change based on professional knowledge and pedagogical skills. Mathematics teachers can use this integrated model as a guide and checklist. According to Azlina, Rohaidah, Mazlini, and Fadzil (2021) teachers carry out their tasks effectively. It is necessary to develop a model that involves the teaching process and the integration of generic skills.

6. Limitations of the Study and Future Directions for Research

We conducted this study based on a literature review and the opinions of experts in mathematics and related education. Therefore, we have identified some limitations to the study.

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1. The selection of expert teachers focuses more on those who teach high school mathematics in Malaysia. The selected mathematics teacher seeks to gather comprehensive insights into the need analysis of this integrated model.

2. This study does not focus on specific mathematical content topics because it focuses more on implementation and epistemology aspects.

Views, suggestions and feedback on several important aspects contributed to the design and development of the model. Therefore, this study recommends that further studies focus on the design and development aspects of an integrated model of mathematics teachers' readiness as agents of change based on professional knowledge and pedagogical skills.

7. Conclusion

This study highlights an urgent need to develop an integrated model of mathematics teachers' readiness as change agents based on professional knowledge and pedagogical skills. Participants highlighted the urgency of prioritizing pedagogical improvements to elevate the national education system to the standards of other developing countries emphasizing the shift from traditional teaching methods to active student engagement. Although this need has been recognized, teacher readiness is still insufficient indicating the need for substantial resources. Future studies should prioritize the comprehensive design of such models, encouraging collaboration among teachers, trainers and curriculum developers to create a more engaging and effective educational experience.

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