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Examining the Competences of Prospective Mathematics Teachers at Some State Islamic Universities in Sumatra

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Abstract. *Prospective teachers face complex 21st-century challenges. Therefore, prospective mathematics teachers must master several competencies to support students in acquiring and applying knowledge, collaborating with others, and developing as individuals. The purpose of this study was to measure the pedagogical, social, professional, and personality competencies of mathematics education students at the state Islamic universities (PTKIN) in Central Sumatra region. This study used a questionnaire on the pedagogical, social, professional, and personality competencies of prospective teachers filled out by 211 students as respondents from 5 state Islamic universities. The findings of the study indicate that mathematics education students at these universities have good pedagogical and social competencies, including lesson planning, assessment, communication, and collaboration, along with solid professional competencies in subject knowledge and material development. While their personality competencies are considered very good because of their ethical behavior and strong work ethic. The universities should still improve 21st-century competencies of students in the curriculum through innovative teaching, internships, social engagement, emotional intelligence workshops, and practical training to improve their competencies and readiness for effective classroom engagement. Further research can assess its effectiveness.*

Keywords*: Prospective Mathematics Teachers, Pedagogical Competence, Personality Competence, Professional Competence, Social Competence*

INTRODUCTION

In developments in the 21st-century, it is crucial for teachers to possess the necessary and suitable competences. The 21st-century presents numerous problems due to the quick pace of change, necessitating education to effectively adapt to these changes (Setyarto et al., 2020). In the 21st-century, learning relies not only on knowledge but also on the important role of skills. Skills have become a vital component needed in various aspects of life. According to Trilling & Fadel (2009), 21st-century skills consist of three categories: life and career skills; learning and innovation skills; and information, media, and technology skills. Essential skills for the 21st-century include special skills that need to be developed through learning, particularly the 4C Skills: critical thinking, problem solving, metacognition, communication, collaboration, innovation, creativity, and information literacy, among others (Wijaya et al., 2016). Thus, education serves as an effort to enhance human welfare and is part of national development (Mardhiyah et al., 2021).

The challenges of the 21st-century are marked by the accelerated development of science, technology, information, and the absence of boundaries between space and time between countries (Kurniawati et al., 2019). Challenges in the teaching and learning process in this technological era are becoming increasingly complicated because environmental changes have influenced students' perceptions of ideas and character (Sada, 2019). Additionally, knowledge generally refers to a society in which knowledge is the primary source of production, rather than capital and labor. In a knowledge society, people create, share, and use knowledge for the prosperity of their people (Malik, 2018).

Competence refers to the quality of a person's behavior and thinking in various settings, as well as their ability to adapt to changing circumstances (Sulaiman & Ismail, 2020). As a result, it is crucial for teachers in the 21st-century to be proficient in a variety of teaching strategies and technological tools. Teachers of the 21st-century are therefore expected to be well-versed in and cognizant of how students of this generation interact with technology (Garba et al., 2015). Teachers also need to be masters of the concepts and learning processes they teach because in the 21st-century, they must be able to help students acquire knowledge, apply that knowledge, collaborate with others, and grow as individuals (Yayuk et al., 2019).

The government recognizes the need to prepare students as global citizens and is committed to enhancing the education system to make Indonesian education internationally competitive. This includes improving various aspects of the education process, such as quality, teaching media, and infrastructure, along with integrating high-tech tools (Fahrozy et al., 2022). In line with this, the Ministry of Education and Culture of Indonesia has formulated a 21st-century learning paradigm that emphasizes students' abilities to research from diverse sources, formulate problems, and think critically and analytically while collaborating to solve issues (Litbang Kemdikbud, 2013).

Besides that, the Mathematics Education study program in state Islamic universities (Perguruan Tinggi Keagamaan Islam Negeri [PTKIN]) that will produce prospective teachers will face a big challenge in being able to produce competitive graduates for the 21st-century. Teaching is the most noble profession, especially teachers who teach in a school environment (Napanoy et al., 2021). To answer this challenge, it can be also seen from the competence of mathematics teachers in the 21st-century. Prospective teachers are students who take part in programs at Education Institutions of Educational Staff (Lembaga Pendidikan Tenaga Kependidikan [LPTK]) (Abdullah, 2015). The result is that prospective mathematics teachers are LPTK students majoring in mathematics education. In accordance with the International Society for Technology in Education, every mathematics teacher competence, namely pedagogical, professional, personality and social competences, must be supported by mastering technological advances. Competence is a group of behaviors that play a role in achieving desired results. In other words, competence is a person's ability to apply or use knowledge, skills, behavior and personal characteristics to carry out difficult tasks in certain roles and positions (Sulaiman & Ismail, 2020).

Prospective teachers who have competences in line with the challenges of the 21st-century will certainly have an impact on the achievement of the students they will teach. Competence is an ability that demands responsibility and must be possessed as a professional teacher (Mafidapuspadina et al., 2021). The word competence means a combination of knowledge, skills, values and attitudes that are reflected in habits of thinking and acting (Diniaty, 2017). The competence of the mathematics teacher influences the mathematical ideas of the material, the effectiveness of the teacher's learning, the range of student learning, and the increasing student understanding (Radite & Retnawati, 2023). The competences of mathematics teachers expected in the 21st-century are competences that are supported by digitalization. One example of the professional competences of mathematics teachers in the 21st-century is that mathematics teachers are able to apply mathematical software in solving mathematics problems that can be displayed in front of students so that students understand mathematics more easily. The social competence of mathematics teachers must also be supported by digitalization, meaning that mathematics teachers must be able to adapt interaction patterns with students, teachers and parents in accordance with science and technology, for example mathematics teachers must be able to use the WhatsApp group, Zoom Meeting and Google Meet applications.

Mathematics education encourages students to understand the relationship between mathematics and other fields (Santamaría-Cárdaba et al., 2021). Other research results obtained were lower for the aspects of creativity, communication and critical thinking than collaborative. This research provides suggestions for teacher competence to answer the challenges of the 21st-century by balancing creativity, communication and critical thinking, supported by meaningful

learning (Yokhebed, 2019). This aligns with the research findings of Wardani & Budiadnya (2023), which indicate that teachers must master skills that support their development into competent educators, particularly in professional and pedagogical competencies. Law Number 14 of 2005 concerning Teachers and Lecturers also confirms that educators possess several competencies, including pedagogical, professional, social, and personality competencies. These four competencies complement each other, shaping teachers into professional individuals (Wardani & Budiadnya, 2023). Meaningful learning can occur if the pedagogical competence, social competence, professional competence and personality competence of mathematics teachers can answer the challenges of the 21st-century.

In accordance with current developments in the 21st-century, prospective teachers who have four teacher competences are needed to be able to answer the challenges of the 21st-century. With this research, it is hoped that many prospective mathematics teachers or Mathematics Education students at PTKIN will have these four competences. Therefore, this research aims to examine the pedagogical, social, professional, and personality competencies of Mathematics Education students at PTKIN.

METHOD

This study adopts a quantitative descriptive research approach, aimed at analyzing the competencies of prospective mathematics teachers. The population targeted in this research includes all third-year mathematics education students from five state Islamic universities in the Central Sumatra region, totaling 448 students. These universities are: UIN Imam Bonjol Padang (UIN IB), UIN Sumatera Utara (UIN SU), UIN Sjech M. Djamil Djambek Bukittinggi (UIN JB), UIN Sultan Thaha Syaifuddin Jambi (UIN STS), and IAIN Kerinci. Using Slovin's formula (1960), the sample size was determined to be 211 students (see Table 1), selected through a proportional random sampling technique to ensure that each institution was appropriately represented based on its student population.

Table 1. Research Subjects

State Islamic Higher Education	Acronyms	Number of Respondents
UIN Imam Bonjol Padang	UIN IB	30 students
UIN Sumatera Utara	UIN SU	84 students
UIN Sultan Thaha Syaifuddin Jambi	UIN STS	33 students
UIN Sjech M. Djamil Djambek Bukittinggi	UIN SMDD	46 students
IAIN Kerinci	IAIN K	18 students
Total		211 students

The data were collected through a questionnaire distributed to all 211 sampled students. The questionnaire was specifically designed to measure the readiness of prospective mathematics teachers to meet the challenges of the 21st-century, as seen through four key competencies: pedagogical, professional, personality, and social competencies. Each competency was measured using 25 statement items, resulting in a total of 100 items. The statements were designed to capture various dimensions of each competency, providing a comprehensive assessment.

The response options provided for each statement consisted of four alternatives: Strongly Agree (SA) (scored 4 for positive statements and 1 for negative ones); Agree (A) (cored 3 for positive statements and 2 for negative ones); Disagree (D) (scored 2 for positive statements and 3 for negative ones); and Strongly Disagree (SD) (cored 1 for positive statements and 4 for negative ones). This scoring system allows for both positive and negative aspects of each competency to be measured, providing a balanced perspective on the students' abilities and areas for improvement.

To ensure the accuracy and reliability of the instrument, the questionnaire underwent testing using Confirmatory Factor Analysis (CFA). This method was employed to examine the

validity and reliability of the instrument through three key considerations: convergent validity, discriminant validity, and construct reliability. Convergent validity, which assesses whether items measuring the same construct are highly correlated. A loading factor value of > 0.4 and an Average Variance Extracted (AVE) value of ≥ 0.5 were used as the criteria (Yamin & Kurniawan, 2011). While discriminant validity, which ensures that constructs that are theoretically unrelated show low correlations, and construct reliability, which measures the internal consistency of the instrument, confirming that the questionnaire consistently measures the intended competencies. Based on this analysis, the questionnaire was confirmed to be both valid and reliable for measuring the competencies of the sample population.

The results from the questionnaire are interpreted based on the teacher competence criteria as outlined by Arikunto (2008) (see Tabel 2). These criteria provide a structured framework for evaluating the level of competence achieved by each student.

Table 2. Students Competence Criteria (Arikunto, 2008)

Percentage of Students Competencies	Criteria
81% – 100%	Very good
61% – 80%	Good
41% – 60%	Moderate
21% – 40%	Bad
0% – 20%	Very Bad

This classification aids in identifying areas where prospective teachers excel and where further development is required, particularly in preparing them to address the demands of modern education.

FINDINGS

The average of the four competencies of prospective mathematics teacher students from five state Islamic universities (PTKIN) in Central Sumatra region shows relatively small variations between institutions, with a range of values between 74.86% and 79.16%, namely 74.86% (UIN IB), 75.54% (UIN JB), 77.50% (UIN SU), 79.00% (IAIN K), and 79.16% (UIN BT). Overall, although there are differences between institutions, the average competency of prospective mathematics teacher students is in a range that can be considered quite good with an average of 79.05%. Meanwhile, the average for each competencies measured is presented in detail in Figure 1.

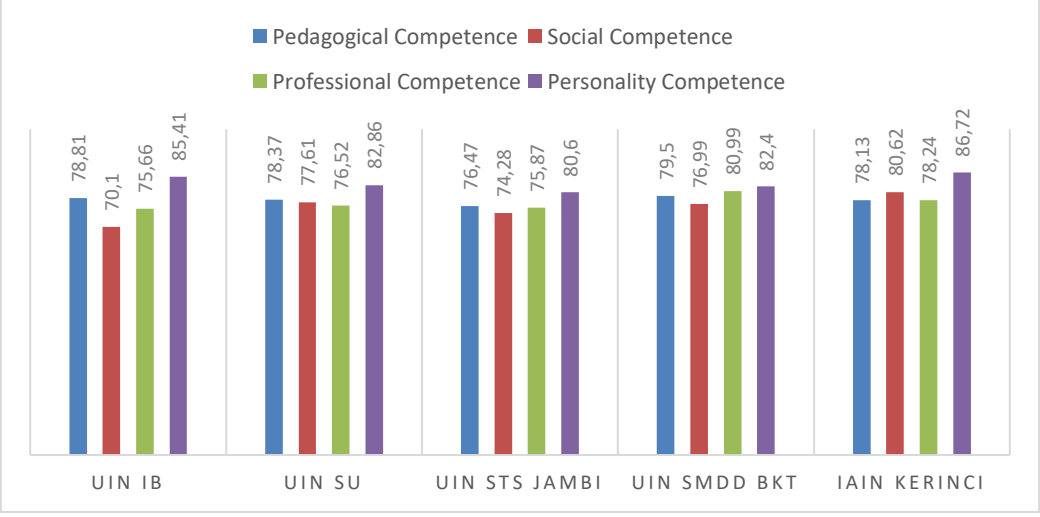

Figure 1. The Detail of Average of Four Competencies of Prospective Mathematics Teachers from 5 State Islamic Universities in Central Sumatra Region

Data from Figure 1 shows that the average pedagogical competence of prospective mathematics teachers is 78.24%, indicating a solid understanding of teaching strategies and classroom management. Social competence, at 76.92%, reflects the need for improvement in communication and interaction skills. Professional competence, averaging 77.45%, suggests a strong grasp of mathematical content, though further enhancement in content delivery is needed. The highest score, 83.60%, is seen in personality competence, highlighting students' integrity, professionalism, and work ethic. While all competencies are at satisfactory levels, focusing on improving social and professional skills would help create more well-rounded and effective teachers.

DISCUSSION

Pedagogical Competence of the Prospective Mathematics Teachers

In general, the average pedagogical questionnaire for Mathematics Education students is classified as good based on score categories of (Arikunto, 2008). This means that Mathematics Education students at PTKIN throughout Central Sumatra already understand students' characteristics, conducting learning planning, organize educative learning, organizing learning assessments and evaluations, use learning strategies supported by technology, and are able to carry out classroom management. Mathematics Education students at PTKIN who are prospective teachers are able to plan their lessons well. This is in line with research which explains that to create a good teaching and learning process, teachers need good planning and the teacher's own teaching skills. Learning tools are very important in the teaching process because they can make it easier for teachers to carry out the learning process (Saifuddin, 2014). Furthermore, by understanding pedagogy, teachers are motivated to develop curriculum and design teaching, learning media, assessment instruments, and so on (Yurniati & Waspodo, 2022). Therefore, pre-service teachers show a high degree of competence in putting ideas into action giving due consideration to the value of feedback in the teaching and learning processes (Afalla & Fabelico, 2020).

The averages for each component of the pedagogical competency of prospective mathematics teachers are presented in Table 3.

Table 3. The Percentages for Each Component of the Pedagogical Competency of Prospective Mathematics Teachers

Pedagogical Competence Components	Percentage (%)	Criteria
Understanding Students' Characteristics	79.75	Good
Conducting Learning Planning	80.7	Good
Organizing Educative Learning	81.65	Very Good
Organizing Learning Assessments and Evaluations	80.48	Good
Using Learning Strategies Supported by Technology	67.74	Good
Classroom Management Skills	79.08	Good

The prominent component of the pedagogical competence of prospective mathematics teachers at PTKIN is the component of organizing educational learning which obtained very good criteria. Based on these results, mathematics education students have been able to carry out educational learning by instilling character values contained in learning to students. In addition, the component of pedagogical competence of prospective mathematics teachers that is still low is the component of using learning strategies supported by technology. Although still in good criteria, this component of pedagogical competence needs to be improved again. Because in the 21st-century, teachers must be able to adapt learning to current developments. Teachers can organize learning strategies that are supported by developing technology. Mathematics education students at PTKIN have been able to organize learning strategies using technology. This is in line

with research conducted by Jamilah (2021) which confirms that the use of technology can foster action in producing interactive learning and ultimately can improve the quality of teaching.

Social Competence of the Prospective Mathematics Teachers

From these results, in general, the average social competence questionnaire for Mathematics Education students is classified as good based on the value categories by (Arikunto, 2008). This means that Mathematics Education students at PTKIN throughout Central Sumatra are able to interact by sharing complaints and input about the class atmosphere with fellow teachers, sharing complaints and input about students with their parents, being able to work together well, being able to position themselves as teachers who are role models for students and society, and being able to interact according to science and technology. Each teacher has a different perspective on teaching so collaboration between fellow teachers is needed to support an optimal learning process (Li & Schoenfeld, 2019). Apart from the school environment, teachers must also be able to interact with the community because teachers must also be able to interact with various complaints and input coming from the community and prepare their students to enter social life. Teachers play a role in preparing their students to become good members of society and the ability to educate and guide society in facing life in the future (Mulyasa, 2013). In addition, teacher social competence plays an important role because as a person who lives in the midst of the community, teachers need to have the ability to mingle with the community, such as the flexibility of getting along (Kamal et al., 2021).

The averages for each component of the social competency of prospective mathematics teachers are presented in Table 4.

Table 4. The Percentages for Each Component of the Social Competency of Prospective Mathematics Teachers

Social Competence Components	Percentage (%)	Criteria
Communication	71.09	Good
Collaboration	81.94	Very Good
Positioning Themselves	80.62	Good
Interacting with Science and Technology	74.02	Good

The prominent component of the social competence of prospective mathematics teachers at PTKIN is working together which obtained very good criteria. Collaboration is needed to support the smooth and successful learning process in the classroom. By working together, teachers can understand how students learn, their characteristics, and also how their environment is so that the teacher can plan good learning to achieve maximum learning goals. Collaboration can also help teachers in positioning themselves as someone who is emulated by students, fellow teachers, parents, and also the community. This is in line with the opinion of Sriyana (2013) which states that teachers must be able to socialize with the community who are consumers of education because they play an important role in the success of the education program in Indonesia.

On the other hand, the social competence component of prospective mathematics teachers that must be improved is communicating and interacting according to science and technology, although these two components have obtained good criteria. Because teachers are not only an example for the school environment, but also an example for the surrounding community. With communication between teachers and students, fellow teachers, students' parents, and the community, it can make learning successful. In addition, in the 21st-century, a teacher's social skills are not only in the real environment. Knowledge coupled with technology can improve a teacher's social competence. Through developing technology, teachers can explore their abilities through technological media. Currently, there are many types of media that can enable teachers to socialize, so teachers must be able to use this technology. On average,

mathematics education students at PTKIN are able to adapt their knowledge to technology. With this technology, prospective teachers can broaden their knowledge and can also find new ideas that are useful for improving the learning process. This is in line with research conducted by Sukono (2018) which states that in terms of a teacher's social skills, teachers can take advantage of developing technology to facilitate communication and can also be used for training a teacher to communicate with students or students' parents.

Professional Competence of the Prospective Mathematics Teachers

From these results, in general, the average of Mathematics Education students' professional questionnaires is classified as good based on the value category by (Arikunto, 2008). This means that Mathematics Education students at PTKIN throughout Central Sumatra have mastered the material that will be taught in learning, are able to develop learning materials creatively, develop professionally, and utilize technology to support learning materials. A teacher is someone who designs, implements and applies the learning process and guides the students in carrying out their obligations in community service (Wahyu et al., 2021). A teacher's professional competence is the ability to master teaching materials widely and in depth which makes it possible to guide students to meet the competence standards set out in national education standards. Teachers who are able to master the learning material will lead students to achieve maximum learning goals (Wardoyo et al., 2013). In simple terms, professional competence for a teacher or educator is a requirement as a profession, not only mastering the material to be taught but also having to really understand learning management or classroom management so that learning management can be carried out more effectively and efficiently and achieve success (Sudjoko, 2020).

The averages for each component of the professional competency of prospective mathematics teachers are presented in Table 5.

Table 5. The Percentages for Each Component of The Professional Competency of Prospective Mathematics Teachers

Professional Competence Components	Percentage (%)	Criteria
Mastering the Basic Competencies of a Subject	79.32	Good
Developing Learning Materials Creatively	79.85	Good
Developing Professionalism	72.77	Good
Utilizing Information and Communication Technology in Supporting Learning Material	77.87	Good

The prominent component is the creative development of learning materials. Teachers are considered professional if they are able to express their creative ideas and are able to develop their knowledge for a smooth and successful learning process. Most mathematics education students at PTKIN are able to develop learning materials creatively. The creative way that is usually done is by linking learning material with daily activities or relevant knowledge and providing learning media that can make it easier for students to understand the lessons being taught. Prospective teachers can also practice materials that are considered new so that abilities can be developed to a higher level.

In addition, what really needs to be improved is the component of developing professionalism and utilizing information and communication technology in supporting learning material. As a teacher in the 21st-century, a teacher's professional competence can also be seen from his or her ability to adapt to developing technology. Teachers must be able to utilize information and learning technology. Communication to support Technology can be used to develop deeper learning so that it is not only focused on one situation. This is in line with research conducted by Yusrizal (2017) which states that teachers must utilize technology as a learning medium to support the professional competence of a teacher in the 21st-century. In addition, the development of professional competence in teachers from professional education

schools should be considered as a purposeful process. Therefore, it should include certain innovative pedagogical and production technologies, modern forms of training future skilled workers, as well as the interaction between actors in the educational process (Abiltarova & Radkevych, 2022).

Personality Competence of the Prospective Mathematics Teachers

From these results, in general, the average score on the personality competence questionnaire for Mathematics Education students is classified as very good based on score categories by Arikunto (2008). This means that Mathematics Education students at PTKIN are able to act in accordance with applicable norms, show exemplary personalities, have a high work ethic, and are responsible as teachers. The presence of teachers in teaching and learning activities is a figure who will be a role model for their students and also the surrounding community (Arfandi & Kandiri, 2021). Therefore, whatever is in the teacher will be reflected through his personality. Because teachers are exemplary people, teachers must show an exemplary personality.

A teacher must be friendly and hospitable to his environment, a firm person, a person who cares about his surroundings, a pleasant person, and a person who can set a good example to students and the community. Furthermore, teachers must be able to control themselves and be wise in dealing with various problems because teachers do not only transfer knowledge, but the way they show the right path is the essence and very few teachers can show it except those who have mental maturity (more precisely said to be a wise teacher) (Anggranei, 2020). Therefore, personality competence must be possessed by the teacher in managing his character and behavior in carrying out his daily duties and obligations as an educator. Teachers are required to have certain characteristics with these traits. It is hoped that all behavior can be imitated properly. No matter how much knowledge you have, it will mean nothing if the teacher cannot be imitated by his character and actions (Arifudin & Ali, 2022).

The averages for each component of the personality competency of prospective mathematics teachers are presented in Table 6.

Table 6. The Percentages for Each Component of The Personality Competency of Prospective Mathematics Teachers

Personality Competence Components	Percentage (%)	Criteria
Acting in Accordance with Applicable Norms	84.13	Very Good
Showing Exemplary Personalities	82.55	Very Good
Having High Work Ethic	83.68	Very Good
Responsibility as a Teacher	84.03	Very Good

The prominent component of personality competence is acting in accordance applicable norms. A teacher who acts in accordance with applicable norms is something very important because the teacher is a role model or a person who is imitated. As a person who is imitated by students and society, the teacher must follow the rules or norms that have been set. Moreover, the component that needs to be emphasized again is showing an exemplary personality. Because teachers are required to be able to provide role models for their students. This is in line with research conducted by Kandiri (2021) which states that the presence of teachers in teaching and learning activities is one of the figures who will be a role model for students and also the surrounding community. Therefore, whatever is in the teacher will be reflected through his or her personality. Because the teacher is a person who is modeled, the teacher must show an exemplary personality. A teacher must be friendly and hospitable to his or her environment, a firm person, a person who cares about his or her surroundings, a pleasant person, and a person who can set a good example to students and the community.

The findings from this study provide a comprehensive overview of the competencies possessed by Mathematics Education students at PTKIN, highlighting their strengths in various

educational domains. It is evident that their solid foundation in pedagogical skills equips them to meet the challenges of modern education. This assessment not only showcases their current abilities but also identifies areas for growth, emphasizing the importance of continual development in an ever-evolving educational landscape. By integrating innovative practices and fostering an environment that encourages feedback and collaboration, PTKIN can further empower these future educators to excel and adapt to the demands of 21st-century teaching.

CONCLUSION

The analysis indicates that the pedagogical competence of Mathematics Education students at some PTKINs is of good quality, as they exhibit a robust understanding of student characteristics, excel in lesson planning, effectively organize educational activities, conduct thorough assessments, leverage technology in learning, and manage classrooms proficiently. Their social competence also is good quality, characterized by strong communication and collaboration skills that enable them to engage effectively in various roles within the educational community while staying attuned to scientific and technological advancements. Furthermore, their professional competence is assessed as good, reflecting mastery of subject knowledge, creativity in developing learning materials, and a proactive approach to professional development through the use of information and communication technology. Additionally, their personality competence is classified as very good, demonstrated by adherence to ethical norms, exemplary behavior, a strong work ethic, and a sense of responsibility as educators. To further enhance 21st-century competencies, it is recommended that policymakers at PTKIN implement innovative teaching methodologies, collect student feedback, facilitate social engagement activities, establish internship programs in collaboration with educational institutions. Encouraging self-reflection through journaling and offering workshops on emotional intelligence will support both personality and social development. Moreover, targeted workshops and practical training can enhance students' competencies and readiness for effective classroom engagement. The implementation of these strategies is expected to improve student competencies, with further research necessary to evaluate their effectiveness.

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