

Analysis Of Technological, Pedagogical, And Content Knowledge (TPACK) Competencies Of Madrasah Ibtidaiyah (PGMI) Teacher Education Students As A 21st Century Learning Framework

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Abstract

Technology plays an important role as a tool, process, and resource for learning and implementing learning. The use of technology apart from offering various opportunities for better and more interesting learning experiences, also poses big challenges. Religion-based educational institutions, in this case madrasahs, are required to be able to adapt to modern scientific discourse. TPACK, which is a knowledge framework, exists to explain the three main components of teacher knowledge (content, pedagogy, and technology). This research aims to describe the TPACK competencies of madrasah ibtidaiyah teacher education students. The method used is descriptive quantitative research method. Data was obtained from students of the Madrasah Ibtidaiyah Teacher Education Study Program (PGMI) Ma'had Aly Al-Hikam Islamic College (STAI) Malang Academic Year 2023/2024 who had implemented the School Field Introduction (PLP) program. The results of the research show that the competency of madrasah ibtidaiyah teacher education students is in the good category with details Technological Knowledge (TK), Content Knowledge (CK) and Pedagogical Content Knowledge (PCK) is categorized as high value while aspect Pedagogical Knowledge (PK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK) is categorized as medium value.

Keywords: 21st Century; TPACK; Madrasah Ibtidaiyah Teacher Education Students

1. Introduction

Technology plays an important role as a tool, process, and resource for learning and implementing learning (Partnership for 21st Century Learning, 2015). The integration of technology in learning is needed as an effort to improve the quality of learning, students' understanding of concepts, and development of students' critical thinking skills (Akturk & Ozturk, 2019). The use of technology apart from offering various opportunities for better and more interesting learning experiences, also poses big challenges. The main obstacle lies in the lack of socio-techno-pedagogical knowledge, self-efficacy and teachers' ability to design and implement useful interventions (Wong et al., 2015). Alternatives that can be done through learning design technology enhanced learning (TEL). Educators are no longer limited to the textbooks provided, but can use other sources such as video, audio and other multimedia parts. With technology enhanced learning (TEL) allows students to access learning resources from any location (Windhu, 2023).

Learning anywhere and anytime is a reality for 21st century students (Faita, 2022). Their learning options include online learning, various types e-learning, and blended learning, which is a combination of traditional face-to-face and online learning. Moreover, most learning materials and resources are available on the internet, 24 hours a day, 7 days a week (Parkay & Stanford, 2011). Through the development of the internet and digital technology, many things have become limitless. The learning process takes place periodically without gaps in space and time. In simple terms, the application and use of technology in the learning process is a necessity, both internally and externally outside class (Ghavifekr et al., 2014). It is not enough for Indonesian people to simply be proficient in reading, writing and arithmetic because technology has resulted in social changes that affect the way we learn and teach. This is a significant challenge for a teacher to turn what technology promises into a reality in learning (Fitriyadi, 2013).

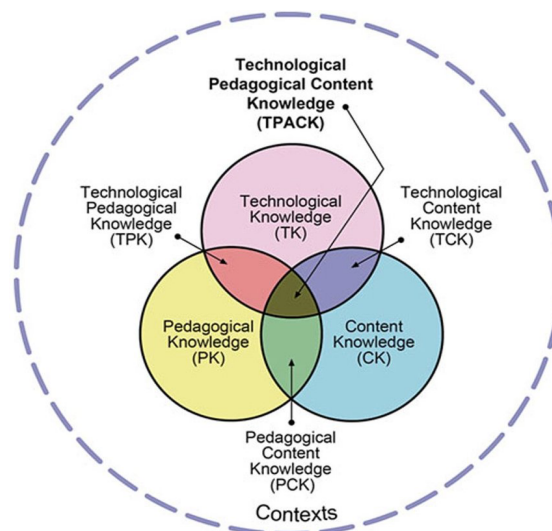
The teacher's role as a facilitator in the learning process must be able to master various knowledge and abilities. (Barber et al., 2007) said that the quality of education will not exceed quality the teacher. In line with the Minister of National Education Regulation Number 16 of 2007 which states that a teacher must have competence in the field of Information and Communication Technology (ICT), having at least two functions, namely ICT as self-development and supporting the learning process (Niarsa, 2013). Teachers are not only required to have knowledge about the material being taught and how to teach it, but are also required to have knowledge about technology and its use in the learning process (Sartono, 2022). However, the ICT competency of teachers in Indonesia is currently categorized as low (Syahid et al., 2021). Many teachers are still technologically illiterate, making it difficult for technology to enter classrooms.

Based on the latest mapping of ICT competencies, adopting the system implemented by the United Nations Educational, Scientific and Cultural Organization (UNESCO) (Suhendri et al., 2020). There are four levels, the first level is ICT literacy or Technology, Information and Communication (ICT) literacy. Second, the level when the teacher is able to operate and apply it easily. Third, the level when teachers are able to create their own content. Meanwhile, at the fourth level, teachers are able to become trainers. Then the results of a survey by the Ministry of Education and Culture were obtained which were reported by the Data and Technology Center of the Ministry of Education and Culture (Fathurrohman, 2020) to 28,000 teachers, it turned out that only 46% of those who had mastered the first level passed. Meanwhile, for the second level, only 14% passed. So it can be described that the level of teacher information and communication technology literacy in Indonesia is still low, namely below 50%. This statement is a common concern in preparing and ensuring that a teacher must be able to choose, evaluate and use technology appropriately to create experiences and student involvement in learning by integrating technology (Handayani et al., 2023). Not only at general education levels such as elementary, middle, high school, vocational school, high school and university, religious-based educational institutions are also expected to be able to develop the quality of their education in the digital era (Haddade, 2023).

The challenges of increasingly complex times require religious-based educational institutions, in this case madrasas, to be able to adapt to modern scientific discourse (Aminuddin, 2019). Madrasah Ibtidaiyah (MI) is a level of education that is the beginning of the formation of the foundations of intellectual, emotional and spiritual intelligence. In several aspects of intelligence, there are literacy competencies that must adapt to the times (*zeitgeist*)

which essentially lies in the teacher's ability (Ibda, 2018). Therefore, the technological literacy of students and teachers must be adequate. In fact, Mishra and Koehler in 2005 researched that apart from teaching materials and pedagogy, technology is also a very important part of successful learning (Mishra & Koehler, 2006). Moreover, future teacher candidates must be ensured to have good technological knowledge, skills and competencies so that they are able to integrate technology in learning effectively and efficiently (Koehler et al., 2011). One effort to integrate technology in learning is through concepts Technological Pedagogical and Content Knowledge (TPACK) (Sukaesih et al., 2017). The existence of TPACK can be used by teachers as a guide in implementing technology in learning.

TPACK is a framework that integrates the relationship between technological knowledge components, pedagogy and content (Spector et al., 2014). In terms of competence, the three are separate parts, but are interconnected. If one component is not met, it can affect other components (Akhwani & Rahayu, 2021). TPACK has become an alternative solution in solving complex problems when teachers integrate ICT into learning (Chai et al., 2013). Through TPACK capabilities, teachers are also able to create innovative and quality learning methods. Anggriawan (2020) explained that teachers who master TPACK competencies can integrate technology in the learning process, according to the material and learning strategies based on student characteristics. The TPACK framework and components can be seen in Figure 1, consisting of: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), iTechnological Pedagogical and Content Knowledge (TPACK) (Kim, 2018).



Gambar SEQ Gambar * ARABIC 1.

In the last ten years, the TPACK framework has become a popular conceptual framework in teacher education (Chai et al., 2013). Many TPACK research results show that this knowledge is important for developing teachers' professional skills (Ratnawati et al., 2022). Research conducted by Baran et al., (2011) states that TPACK is an effective tool and component that can be used by teachers to improve their mastery of technology, pedagogy, and mastery of learning materials. In the future, teachers will face many challenges. Therefore, in order to remain relevant as professional teachers, they must immediately adapt and enrich themselves through

the use of technology in learning. There is no guarantee that a teacher's wealth of material knowledge is directly proportional to his pedagogical and technological competence (Akhwani & Rahayu, 2021). They may be academically bright, but lack teaching skills and are weak in technology. It is also not an inevitability, when teachers who have material knowledge and high pedagogical competence are also proficient in technology.

Departing from the descriptions above, it is important to carry out research on the TPACK competency analysis of prospective teachers because several studies show that many teacher education graduates feel less ready to use technology to support the teaching and learning process after they start teaching at school (Handayani et al., 2023). This research aims to describe how competence is Technological Pedagogical and Content Knowledge (TPACK) madrasah ibtidaiyah teacher education students. The theoretical benefit of the research is that it enriches scientific references regarding the competency of madrasah ibtidaiyah teacher education students, while practically it serves as an initial reference in increasing student competency. In the research conducted there were several limitations. The limitations of this research are described as follows: (1) The subjects of this research were only students who had taken teaching programs in schools (2) This research only measured students' self-assessment of the TPACK domain. Research hypothesis: 7 out of 10 students say that the use of technology in their learning environment is still inadequate. Often use Powerpoint media in learning and sometimes just use a conventional whiteboard. This hypothesis is not tested, only used as a focus for research and determining what data needs to be collected.

Technology Enhanced Learning

Technology has become an integral part of modern life, including in the field of education. Merriam-Webster Dictionary defines technology as a technical process, method or knowledge used to complete a task. The use of ICT in education is known as Technology Enhanced Learning (TEL) (Baneres et al., 2019). This theory emphasizes that technology can be an effective tool for improving learning. The use of technology provides access to a more varied learning resource, allows learning to be tailored to individual learning styles and intelligence and facilitates collaborative learning (Anderson & Dron, 2011). Technology includes various tools such as multimedia computers, internet, cell phones, smart boards, video tapes, chat rooms online, page web, audio-interactive conferencing, and so on. TEL aims to improve the teaching and learning process and student learning outcomes (Windhu, 2023).

Technology-enhanced learning design is inherently a challenging task (Mor & Winters, 2008) because it must meet realistic needs and solve complex design problems. (Ruthven, 2007) identified the main structures in TEL integration, which are needed by teachers to build their expert knowledge according to: work environment, resource system, activity format, curriculum script and time economy. Thus, digital media integration goes beyond traditional learning planning, even instructional design models. Like the words designing technology-based learning or TEL requires "think outside the box" because it integrates new learning activities, new ways of learning expression digitally, new patterns of social orchestration and spatial arrangement (Kynigos in Papanikolaou et al., 2017). These challenges are expressed in the field of TEL teacher education as a form of concern about the inadequacy of teacher preparation programs that address technology, pedagogy and content knowledge separately (Angeli & Valanides, 2009)

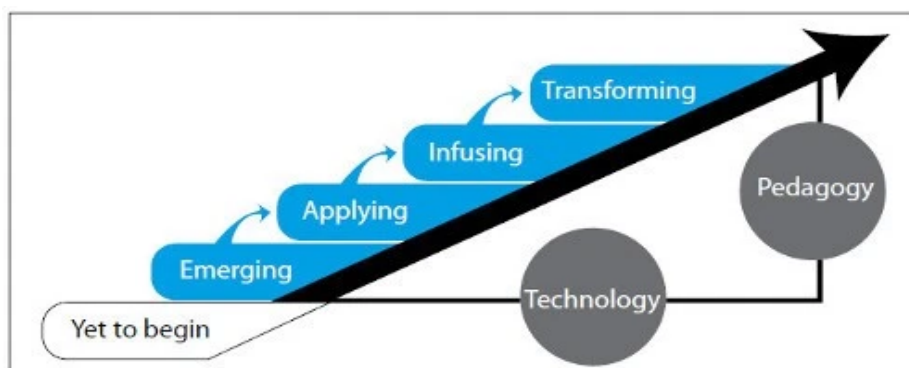
Technological knowledge – in the sense of ICT literacy seems to be the main focus of the prevailing paradigm in teacher preparation programs (Angeli & Valanides, 2005). The criticism of this rationale lies in the fact that equipping teachers with adequate knowledge is not naturally enough to combine their technology skills with teaching methods and material knowledge (Papanikolaou et al., 2017). As argued (Ruthven, 2009) “understanding the challenges of incorporating new technologies into classroom practice requires developing a naturalistic perspective that situates their adoption and use within the everyday work of teaching”. In line with this thinking, several approaches have emerged in the field, making design an important activity in the teaching profession and calling for the repositioning of teachers from transmitters of knowledge to designers of learning. The view of "teachers as designers" of learning was introduced by Mishra & Koehler (2006) with the term TPACK. A knowledge framework that combines technology, pedagogy and content knowledge.

Thus Technology Enhanced Learning (TEL) and Technological Pedagogical Content Knowledge (TPACK) has a very close relationship. TEL refers to the use of technology to improve the teaching and learning process, while TPACK is a framework that helps teachers integrate technology effectively in learning. In other words, teachers who have good TPACK will be able to determine and use the right technology to support student learning.

Level integration of technology UNESCO

The integration of technology in learning is nothing new (Purnasari & Sadewo, 2020). Several studies have been conducted to find out how the use of technology impacts learning. Research by Ahmad et al., (2021) applying animation technology and computer simulation to electrochemical learning material showed good results. Students understand and are more motivated to study chemistry. (Chaeroni et al., 2019) use i-spring suite 8 in mathematics learning. The results show that students have increased abilities in understanding and solving mathematical problems. It is inevitable that technology has brought new challenges for teachers in developing learning (Juanda et al., 2021).

UNESCO (2002) in a document entitled “Information and Communication Technology in Education: a Curriculum for Schools and Programme of Teacher Development” publishes a framework for measuring ICT integration in the curriculum which consists of 4 stages, namely: emerging, applying, infusing dan transforming. These four stages constitute the ICT integration continuum model which is presented in Figure 2 as follows,



Gambar SEQ Gambar * ARABIC 2. Model Kontinum Integrasi TIK

The model in Figure 2 functions as a representation framework for a school or educational institution to determine the position of the level/level of ICT integration in a curriculum. The continuum model has two dimensions, namely technology and pedagogy. Technology refers to the entire scope of ICT which represents the increasing number and variety of uses, while pedagogy is the art and science of teaching which represents changes in teaching practice resulting from the application of ICT (Fitriyadi, 2013). Specifically, the explanation of the stages is as follows:

- Emerging (appear)

This stage is marked by the use of ICT by schools at the initial stage. Schools or educational institutions usually begin to explore the potential for using ICT in organizational management activities and weigh the advantages and disadvantages (Syaifudin, 2021). Schools still apply conventional learning systems, but there is already concern about the importance of using ICT in the educational context. Teachers still use available technology for their own purposes, such as word processors to prepare worksheets, spreadsheet to manage class lists and, if the internet is also available, to search for information or communicate via e-mail. The focus lies on learning to use various tools and applications so that they become aware of the potential of ICT in the future learning process. At stage Emerging, classroom practice is still very teacher-centered (teacher-centered).

- Applying (apply)

This stage is characterized by a better understanding of the benefits and efforts to apply ICT in the context of school management and learning. Generally there is a national policy regarding the application of ICT. Schools are starting to make ICT an object that must be mastered or studied (learning to use ICT). Learning activities are starting to be given a touch of technology, although it is still only a complement. In addition, several teacher activities are starting to use technology to manage organizations. They use ICT for professional purposes such as focusing on improving the teaching of subjects that are enriched by how they teach with various ICT applications (Fitriyadi, 2013). At stage Applying, the curriculum is also starting to be adjusted to accommodate more optimal use of technology.

- Infusing (embed)

This stage requires efforts to integrate ICT into the curriculum. Schools or educational institutions have made ICT as a learning medium (using ICT to learn) by implementing computer-based technology in laboratories, classes and administration. Technology too It has been used in all aspects of education, both in learning and managing institutions. Teachers are at the stage of exploring new ways in which ICT is changing their productivity and professional work to improve student learning and learning management. Naturally, they collaborate with fellow teachers to solve problems and share teaching experiences. At stage Infusing, activity learning has been designed to utilize technology and focus on real life (Syaifudin, 2021).

- Transforming (change)

This stage is marked by the school's efforts to make ICT a catalyst for learning renewal. ICT is an important part of everyday life at school so that classes are fully integrated in learning.

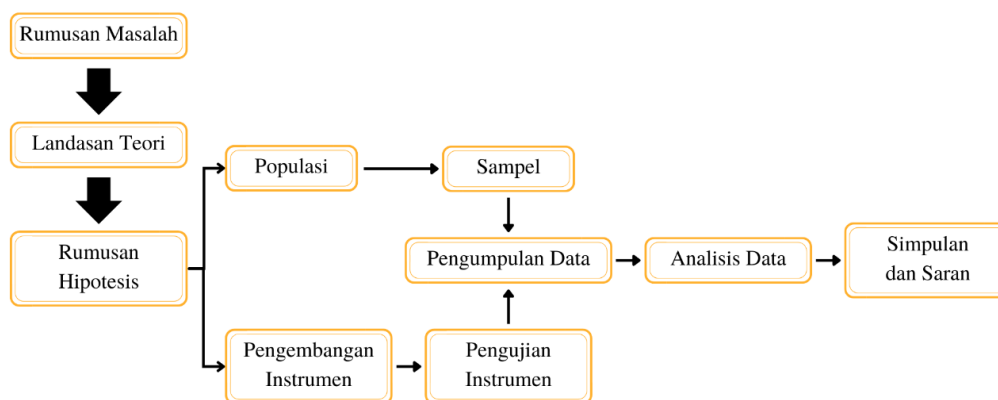
Teachers already have confidence in the ease and use of ICT by creating teaching materials completely using technology. Although not visible in terms of personal productivity and professional practice, the focus in the classroom has moved completely from teacher-centered to student-centered (student-centered) and oriented to real life (Fitriyadi, 2013). Because the use of technology is so integrated in both learning and institutional management activities that at this stage Transforming Some activities cannot even be carried out without using technology.

This UNESCO framework is not the only way to measure the integration of ICT in the curriculum. There are several other frameworks such as SAMR (Substitution, Augmentation, Modification, dan Redefinition) Which developed by Puentedura in 2006 (Romrell et al., 2014), TIM (Technology Integration Matrix) developed by Florida Centre for Instructional Technology (FCiT) in 2006 (Welsh et al., 2011) and many others.

2. Method

This research uses a quantitative approach with survey methods and descriptive analysis techniques. Quantitative research is a process of finding knowledge that uses data in the form of numbers as a tool to find information about what we want to know (Darmawan, 2014). According to Ruslan (2004) the survey method is a method of collecting primary data by obtaining it directly from research field sources through questionnaires and interviews both verbally and in writing. Meanwhile, descriptive is research conducted to determine the value of independent variables, either one or more variables (independent) without making comparisons, or connecting them with other variables (Sugiyono, 2013). This is in line with the research objective, namely to describe the TPACK competencies of madrasah ibtidaiyah teacher education students.

The stages of this research are explained in Figure 3 as follows,



Gambar SEQ Gambar * ARABIC 3. Tahapan Penelitian menurut (Sugiyono, 2013)

The population in this study were students of the Madrasah Ibtidaiyah Teacher Education Study Program (PGMI) Ma'had Aly Al-Hikam Islamic College (STAI) Malang Academic Year 2023/2024 who had implemented the School Field Introduction (PLP) program. Determination of samples using saturated sampling where all members of the population are used as a sample. This is often done when the population is relatively small, less than 30 people, or research that wants to make generalizations with very small errors. Another term for saturated sampling is census, where all members of the population are used as samples (Sugiyono, 2013)

The data collection technique uses a research instrument in the form of a questionnaire containing 50 questions based on research (Schmidt et al., 2009; Suyamto et al., 2020; Murtiyasa & Atikah, 2021; Sulistiani, 2022) which is modified according to research needs, explained in Table 1. The questionnaire containing seven aspects of TPACK was developed based on several indicators. Each aspect contains an indicator of ability which is measured using a Likert scale consisting of 5 points, namely 1 for Strongly Disagree (STS), 2 for Disagree (TS), 3 for Undecided (R), 4 for Agree (Agree), and 5 to Strongly Agree (SS) (Joshi et al., 2015)

Table 1. Modification of Research Instruments

No.	Source	Statement Modification	Indicator	Reference
Technological Knowledge				
1.	By definition technological knowledge refers to knowledge of a variety of technologies, ranging from low-tech technologies such as pencils and paper to digital technologies such as the internet, digital video, interactive whiteboards, and software programs.	I use simple technology such as pencils, paper and blackboards in learning	Knowledge of various technologies, hardware and software	Schmidt, et al., (2009)
2.	Based on the statement that says "skilled in using a laptop, camera and projector"	I use hardware in learning such as laptops, computers, tablets, LCD projectors and so on		Murtiyasa & Atikah, (2021)
3.	By definition technological knowledge refers to knowledge of a variety of technologies, ranging from low-tech technologies such as pencils and paper to digital technologies such as the internet, digital video, interactive whiteboards, and software programs.	I use software in audio-visual based learning such as Google Slides, Powerpoint, Canva, Prezzi and others for presenting material		Schmidt, et al., (2009)
4.	By definition technological knowledge refers to knowledge of a variety of technologies, ranging from low-tech technologies such as pencils and paper to digital technologies such as the internet, digital video, interactive whiteboards, and software programs.	I use software in learning such as game-based e-learning platforms (Quizziz, Kahoot, Duolingo, Anatomy Arcade, etc.)		Schmidt, et al., (2009)
5.	By definition technological knowledge refers to knowledge of a variety of technologies, ranging from low-tech technologies such as pencils and paper to digital technologies such as the internet, digital video, interactive whiteboards, and software programs.	I am aware of the concepts of more advanced digital technologies such as artificial intelligence (AI), augmented reality (AR) or virtual reality (VR)		Schmidt, et al., (2009)
6.	Based on the statement that says "the technology used is easy to operate"	The technology I use is easy to operate	Skills in using technology	Suyamto et al., (2020),
7.	Based on the statement that reads "the technology used has succeeded in increasing student interest and motivation"	The technology I use has succeeded in increasing student interest and motivation		Suyamto et al., (2020),
8.	Based on the statement that says "the technology used has an	The technology I use in learning has an appeal to		Suyamto et al., (2020),

No.	Source	Statement Modification	Indicator	Reference
	attraction for students"	students		
Pedagogical Knowledge (Pedagogical Knowledge)				
1.	Based on the definition pedagogical knowledge refers to methods and teaching processes and includes knowledge in classroom management, assessment, lesson plan development, and student learning	I develop specific and measurable learning objectives for each learning session	Planning learning activities	Schmidt, et al., (2009)
2.	Based on the definition pedagogical knowledge refers to methods and teaching processes and includes knowledge in classroom management, assessment, lesson plan development, and student learning	I determine the learning model based on student learning styles		Schmidt, et al., (2009)
3.	Based on the statement that reads "using varied assessment methods and techniques"	I use a variety of assessment methods and techniques		Suyamto et al., (2020),
4.	Based on the definition pedagogical knowledge refers to methods and teaching processes and includes knowledge in classroom management, assessment, lesson plan development, and student learning	I adapt my learning approach to accommodate individual differences		Schmidt, et al., (2009)
5.	Based on the statement that reads "able to take reflective action to improve the quality of learning"	I evaluate student progress during and after learning	Learning evaluation	Murtiyasa & Atikah, (2021)
6.	Based on the statement that reads "I can guide students to discuss effectively during group learning"	I use statements or discussions as a tool to encourage deep understanding		Sulistiani (2022)
7.	Based on the statement that says "master and manage the class well"	I manage student behavior in the classroom to create an environment conducive to learning		Suyamto et al., (2020)
Content Knowledge (Content Knowledge)				
1.	Based on the statement that says "I have sufficient knowledge about my subject"	I have sufficient knowledge about the material taught	Mastery of the content of the material taught	Sulistiani (2022)
2.	Based on the definition, content knowledge is knowledge about the actual subject matter that will be studied or taught	I ensure that the material I present to students is accurate and up to date		Schmidt, et al., (2009)
3.	Based on the statement that says "able to provide examples of relevant questions"	I provide examples or case studies that are relevant in everyday life		Murtiyasa & Atikah, (2021)
4.	Based on the statement that says "answer students' statements correctly"	I answered students' statements appropriately		Suyamto et al., (2020)
5.	Based on the definition, content knowledge is knowledge about the actual subject matter that will be studied or taught	I provide teaching materials that can be accessed and understood by all students even with different learning styles	Teaching materials	Schmidt, et al., (2009)
6.	Based on the statement that reads "conduct material analysis based on its difficulty"	I align the level of complexity of teaching material with the level of student understanding		Murtiyasa & Atikah, (2021)
7.	Based on the statement that reads	I use the latest sources such		Suyamto et

No.	Source	Statement Modification	Indicator	Reference
	"using the latest sources such as books, journals, to improve the knowledge of biology that we have"	as books, journals, articles to increase the knowledge I have		al., (2020)
Pedagogical Technological Knowledge (Technological Pedagogical Knowledge)				
1.	Based on the statement that reads "able to choose technology that suits the learning approach and strategy"	I choose technology that suits my learning approach and strategy	Technology-based learning design	Murtiyasa & Atikah, (2021)
2.	Based on the statement that reads "I can facilitate students in using technology to build various forms of knowledge representation"	I use technology to build various representations of students' knowledge		Sulistiani (2022)
3.	Based on the statement that reads "facilitating students to use technology to find more information independently"	I facilitate students using technology to find more information independently		Murtiyasa & Atikah, (2021)
4.	Based on the statement that says "I can facilitate students to collaborate with each other using technology"	I facilitate students to collaborate with each other using technology		Sulistiani (2022)
5.	Based on the statement that says "I can facilitate students to use technology to plan and monitor their own learning"	I ensure the use of technology tools and resources is appropriate to student needs and preferences	Ability to use technology tools and resources	Sulistiani (2022)
6.	Based on the statement that reads "using computer applications in learning"	I use computer media (text, graphics, images and audio) as interactive learning media		Suyamto et al., (2020)
7.	Based on the statement that reads "using internet facilities to communicate with students, for example to collect assignments or teaching materials"	I use social media to communicate with students regarding teaching materials or collect assignments		Suyamto et al., (2020)
Content Pedagogical Knowledge (Pedagogical Content Knowledge)				
1.	Based on the statement that reads "able to choose learning strategies that are appropriate to the material to be presented"	I choose learning approaches and strategies that are appropriate to the material being taught	Ability to manage learning content	Murtiyasa & Atikah, (2021)
2.	Based on the statement that reads "mastering the correct flow of presentation so that it is easily understood by students"	I ensure that the presentation of learning material is not only informative but also interesting		Murtiyasa & Atikah, (2021)
3.	Based on the statement that says "without using technology, I can overcome common learning difficulties experienced by my students for my subject"	I identify and respond to students' difficulties in learning the material studied	Dialogic learning	Sulistiani (2022)
4.	Based on the statement that says "without using technology, I can facilitate meaningful discussions about the content students learn in my courses"	I facilitate students with discussions about the content learned in my courses		Sulistiani (2022)
5.	Based on the statement that says "without using technology, I can involve students in solving real-world problems related to my subject"	I engage students in solving real world problems related to my subject		Sulistiani (2022)
6.	Based on the statement that reads "provide questions to measure students' understanding of the material being studied"	I give questions to measure students' understanding of the material being taught	Ability to manage learning content	Suyamto et al., (2020)
7.	Based on the statement that reads	I reflect and evaluate student		Suyamto et

No.	Source	Statement Modification	Indicator	Reference
	"provide questions to measure students' understanding of the material being taught"	learning on the material taught		al., (2020)
Content Technology Knowledge (Technological Content Knowledge)				
1.	Based on the statement that reads "able to master technology relevant to the material to be presented"	I use technology that is relevant to the material being taught	Integration of technology with subject matter	Murtiyasa & Atikah, (2021)
2.	Based on the statement that reads "developing student activities and assignments that involve the use of technology"	I develop activities and tasks that involve the use of technology		Suyamto et al., (2020)
3.	Based on the statement that reads "I know the technology that I should use to teach my subject matter"	I determine appropriate content to be developed in multimedia form based on the complexity of the material		Sulistiani (2022)
4.	Based on the statement that says "I can use software created specifically for my subject (ex. Electronic dictionary, Encyclopedia, Wikipedia)"	I use software (Google Slides, Powerpoint, Canva, Prezzi, etc.) created specifically for my subject		Sulistiani (2022)
5.	Based on the statement that reads "facilitating students to use technology to find more information independently"	The technology I use provides unlimited material information	Selection of the right technology	Murtiyasa & Atikah, (2021)
6.	Based on the statement that says "I understand which material requires technological facilities to make it easier for students to learn"	The technology I use makes it easier for students to learn		Sulistiani (2022)
7.	Based on the statement that says "the technology used can improve students' understanding"	The technology I use can improve student understanding		Sulistiani (2022)
Knowledge of Pedagogical Technology and Content (Technological Pedagogical and Content Knowledge)				
1.	Based on the statement that says "I can design lessons that appropriately integrate content, technology and pedagogy for student-centered learning"	I design learning that appropriately integrates content, pedagogy and technology that is student-centered	Knowledge of content, pedagogies, and technologies integrated into learning	Sulistiani (2022)
2.	Based on the statement that reads "expert in combining material knowledge, pedagogical knowledge and technological knowledge"	I combine content knowledge, pedagogical knowledge, and technological knowledge to create effective learning		Murtiyasa & Atikah, (2021)
3.	Based on the statement that reads "able to choose learning strategies and technology or teaching aids that are appropriate to the material to be delivered"	I determine the tools and materials that can be used to teach the material through appropriate learning models and approaches		Murtiyasa & Atikah, (2021)
4.	Based on the statement that says "I can create independent learning activities from knowledge content with appropriate ICT tools (ex. Edmodo, Google Classroom, Blog, Web, etc.)"	I create independent learning activities from knowledge content with appropriate ICT tools (Edmodo, Google Classroom, Blog, Web, etc.)	21st century digital learning	Sulistiani (2022)
5.	Based on the statement that reads "I can organize activities to help students build different representations of content knowledge using appropriate ICT (ex. Edmodo, Google Classroom, Blog, Web, etc.)"	I structure activities to help students build different representations of content knowledge using appropriate ICT (Edmodo, Google Classroom, Blog, Web, etc.)		Sulistiani (2022)

No.	Source	Statement Modification	Indicator	Reference
6.	Based on the statement that says "I can design inquiry activities to guide students to understand content knowledge with appropriate ICT tools (ex. Edmodo, Google Classroom, Blog, Web, etc.)"	I design inquiry activities to guide students to understand content knowledge with appropriate ICT tools (Edmodo, Google Classroom, Blog, Web, etc.)		Sulistiani (2022)
7.	Based on the statement that reads "I can formulate in-depth discussion topics about knowledge content and facilitate student online collaboration with appropriate tools (ex. Edmodo, Google Classroom, Blog, Web, etc.)"	I guide students to draw conclusions about the material by utilizing appropriate ICT-based learning media (Edmodo, Google Classroom, Blog, Web, etc.)		Sulistiani (2022)

The research instrument had previously been validated by the supervising lecturer and tested on respondents outside the research sample who had similar characteristics, namely Islamic Religious Education (PAI) students at the Ma'had Aly Al-Hikam Islamic College (STAI) Malang. Validity testing using assistance Software IBM SPSS ver. 23, This is done to find out whether the research instrument can measure what it should measure by correlating each item and the total score in the instrument used Corrected item-total correlation. High correlations between items in an instrument indicate that they measure the same thing.

The sample used for testing consisted of 30 respondents with a significance level of 5% in the distribution of r values in the statistical table. Based on the df value (degree of freedom) in research with the formula ($df = n \text{ (number of respondents)} - 2$) obtained a value of 28 with $r_{table} = 0.374$. According to Wiratna (2014) questions on the questionnaire are declared valid if $r_{count} > r_{table}$ on the contrary, the questionnaire is declared invalid when $r_{count} < r_{table}$. Based on the results of the trial analysis of the validity of the instrument, 48 of the 50 questions were declared valid while the other 2 were invalid in question items TK_3 with a value of 0.352 and TK_4 with a value of 0.047.

Reliability test using Cronbach 's Alpha which is an internal reliability index. Reliability testing is carried out to determine the extent to which the instrument produces consistent data, which can be proven by the question items being correlated with each other. A high value indicates the instrument is reliable. According to Wiratna (2014) if the value Cronbach 's Alpha > 0.60 then the instrument is said to be reliable, and vice versa the instrument is said to be unreliable if the value Cronbach 's Alpha < 0.60 . Based on the results of the analysis of valid instrument reliability trials, all of them were declared reliable with aspect values TK 0.823, PK 0.861, CK 0.882, TPK 0.844, PCK 0.851, TCK 0.857 and TPACK 0.920. The overall results of the instrument's validity and reliability tests can be seen in **Appendix**

In this research, the data analysis technique used is descriptive statistical analysis technique. The data display is in the form of a table showing information about the frequency distribution consisting of minimum and maximum values, centric calculations consisting of mean, median, mode and dispersion measures consisting of standard deviation (Hidayati et al., 2019). Research data will be described into medium low and high categories based on a normal distribution model using hypothetical statistics, the formula can be seen in Table 2 as follows,

Table 2. Hypothetical Statistical Categorization Formula

$$\begin{aligned}
 X_{min} &= \text{number of items } x \text{ lowest measuring value} \\
 X_{max} &= \text{number of items } x \text{ highest measuring value} \\
 \text{Mean}(\mu) &= (X_{max} + X_{min}) / 2 \\
 \text{Range} &= X_{max} - X_{min} \\
 \text{Standard Deviation}(\sigma) &= \text{range} / 6
 \end{aligned}$$

Category	Formula
Low	$X < (\mu - 1. p)$
Currently	$(\mu - 1. p) \leq X < (\mu + 1. p)$
High	$(\mu + 1. \sigma) \leq X$

*This categorization guide is based on (Azwar, 2022)

3. Results and Discussion

3.1 Result

Data obtained from distributing online questionnaires to Madrasah Ibtidaiyah Teacher Education (PGMI) Ma'had Aly Al-Hikam Malang Islamic High School (STAI) students regarding competency Technological Pedagogical and Content Knowledge (TPACK) is presented in shape The table is in accordance with descriptive statistical analysis techniques. TPACK competency analysis is divided into several aspects, namely, Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical and Content Knowledge (TPACK). The presentation of the research results is described in Table 3 as follows,

Table 3. Descriptive Statistics Data

	TK	PK	CK	PCK	TCK	TPK	TPACK
N	Valid	22	22	22	22	22	22
	Missing	0	0	0	0	0	0
Mean	22.77	25.59	26.14	26.91	24.82	24.91	22.77
Median	23.50	25.00	26.50	26.50	24.50	23.50	22.50
Mode	24	21 ^a	27	26	21 ^a	21	21 ^a
Std. Deviation	3.611	4.295	3.870	4.450	4.382	4.608	3.690
Minimum	14	18	19	20	18	18	17
Maximum	30	35	33	35	33	34	32

a. Multiple modes exist. The smallest value is shown

Based on Table 3, it can be seen that the data shows the total average value (mean), middle value (median), the most frequently occurring value (mode), standard deviation, minimum value and maximum value from 22 respondents. Kindergarten aspects gain value mean 22.77, value median 23.50, value mode 24, standard deviation 3.611, minimum score 14 and maximum score 30. The PK aspect received a score mean 25.59, value median 25.00, value

mode 21, standard deviation 4.295, minimum score 18 and maximum score 35. The CK aspect obtained a score mean 26.14, value median 26.50, value mode 27, standard deviation 3.870, minimum score 18 and maximum score 33. The PCK aspect obtained a score mean 26.91, value median 26.50, value mode 26, standard deviation 4,450, minimum score 20 and maximum score 35. The TCK aspect obtained a score mean 24.82, value median 24.50, value mode 21, standard deviation 4.382, minimum score 18 and maximum score 33. The Corruption Eradication Committee aspect received a score mean 24.91, value median 23.50, value mode 21, standard deviation 4.608, minimum value 18 and maximum value 34. The TPACK aspect obtained a value mean 22.77, value median 22.50, value mode 21, standard deviation 3,690, minimum value 17 and maximum value 32. Then these values are categorized based on hypothetical statistical formulas and the following results are obtained,

Table 4. Categorization of Aspects Technological Knowledge (TK)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	currently	5	22.7	22.7	22.7
	height	17	77.3	77.3	100.0
	Total	22	100.0	100.0	

In Table 4 it can be seen that the data shows the level of competency Technological Knowledge (TK) PGMI STAI Ma'had Aly Al-Hikam Malang students are divided into 2 categories. Of the total respondents, 5 respondents received the medium category with a percentage of 22.7%. Meanwhile, 17 respondents received the high category with a percentage of 77.3%. This shows that respondents have been able to use technology in learning and some of them are even very good at utilizing various hardware such as laptops/computers, cellphones/tablets, and various types of software. Most competency levels Technological Knowledge (TK) students are in the high category.

Table 5. Categorization of Aspects Pedagogical Knowledge (PK)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	currently	12	54.5	54.5	54.5
	height	10	45.5	45.5	100.0
	Total	22	100.0	100.0	

In Table 5 it can be seen that the data shows the level of competency Pedagogical Knowledge (PK) PGMI STAI Ma'had Aly Al-Hikam Malang students are divided into 2 categories. Of the total respondents, 12 respondents were in the medium category with a percentage of 54.5%. Meanwhile, 10 respondents were in the high category with a percentage of 45.5%. This shows that the respondents have quite good pedagogical competence. Includes the ability to adapt learning to students' characteristics, understanding and possible misconceptions. Most competency levels Pedagogical Knowledge (PK) students are in the medium category.

Table 6. Categorization of Aspects Content Knowledge (CK)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	currently	9	40.9	40.9	40.9
	height	13	59.1	59.1	100.0
	Total	22	100.0	100.0	

In Table 6 it can be seen that the data shows the level of competency Content Knowledge (CK) PGMI STAI Ma'had Aly Al-Hikam Malang students are divided into 2 categories. Of the total respondents, 9 respondents were in the medium category with a percentage of 40.9%. Meanwhile, 13 respondents were in the high category with a percentage of 59.1%. This shows that respondents before entering the classroom were prepared to equip themselves with an understanding of theories, concepts and examples of questions related to everyday life. Most competency levels Content Knowledge (CK) students are in the high category.

Table 7. Categorization of Aspects Technological Pedagogical Knowledge (TPK)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	currently	14	63.6	63.6	63.6
	height	8	36.4	36.4	100.0
	Total	22	100.0	100.0	

In Table 7 it can be seen that the data shows the level of competency Technological Pedagogical Knowledge (TPK) PGMI STAI Ma'had Aly Al-Hikam Malang students are divided into 2 categories. Of the total respondents, 14 respondents were in the medium category with a percentage of 63.6%. Meanwhile, 8 respondents were in the high category with a percentage of 36.4%. This shows that respondents are quite capable of utilizing technology well in the learning process. Most competency levels Technological Pedagogical Knowledge (TPK) students are in the medium category.

Table 8. Categorization of Aspects Pedagogical Content Knowledge (PCK)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	currently	6	27.3	27.3	27.3
	height	16	72.7	72.7	100.0
	Total	22	100.0	100.0	

In Table 8 it can be seen that the data shows the level of competency Pedagogical Content Knowledge (PCK) PGMI STAI Ma'had Aly Al-Hikam Malang students are divided into 2 categories. Of the total respondents, 6 respondents were in the medium category with a percentage of 27.3%. Meanwhile, 16 respondents were in the high category with a percentage of 72.7%. This shows that respondents understand how to choose an approach or method to convey certain material or content in learning. Most competency levels Pedagogical Content Knowledge (PCK) students are in the high category.

Table 9. Categorization of Aspects Technological Content Knowledge (TCK)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	currently	12	54.5	54.5	54.5
	height	10	45.5	45.5	100.0
	Total	22	100.0	100.0	

In Table 9 it can be seen that the data shows the level of competency Technological Content Knowledge (TCK) PGMI STAI Ma'had Aly Al-Hikam Malang students are divided into 2 categories. Of the total respondents, 12 respondents were in the medium category with a percentage of 54.5%. Meanwhile, 10 respondents were in the high category with a percentage of 45.5%. This shows that respondents are quite capable of making good use of technology as a tool in delivering material. Most competency levels Technological Content Knowledge (TCK) students are in the medium category.

Table 10. Categorization of Aspects Technological Pedagogical and Content Knowledge (TPACK)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	currently	18	81.8	81.8	81.8
	height	4	18.2	18.2	100.0
	Total	22	100.0	100.0	

In Table 10 it can be seen that the data shows the level of competency Technological Pedagogical and Content Knowledge (TPACK) PGMI STAI Ma'had Aly Al-Hikam Malang students are divided into 2 categories. Of the total respondents, 18 respondents were in the medium category with a percentage of 81.8%. Meanwhile, 4 respondents were in the high category with a percentage of 18.2%. This shows that respondents seem to have difficulty integrating technological, content and pedagogical knowledge in learning. Most levels Technological Pedagogical and Content Knowledge (TPACK) students are in the medium category.

3.2 Discussion

Technological Pedagogical And Content Knowledge (TPACK) is the teacher's knowledge of how to facilitate student learning of certain content using pedagogical and technological approaches (Cox & Graham, 2009). In connection with technological developments and the need for teacher professionalism, it is important to have an understanding of the TPACK framework in order to integrate technology into learning. Prospective teachers are expected to understand various competency factors that can help improve teacher professionalism, so that they can use technology as preparation to face global challenges (Fuada et al., 2020).

Based on the UNESCO framework (2002) in the document entitled "Information and Communication Technology in Education: a Curriculum for Schools and Programme of Teacher Development" which functions to measure the integration of ICT in the curriculum in schools or educational institutions. The results obtained were that the students of the PGMI STAI Ma'had Aly Al-Hikam Malang Study Program were already at the infusing (implant) they have made ICT

as a learning medium (using ICT to learn). Students utilize technology by designing learning activities that are oriented to real life. These findings were obtained from observation and document analysis based on TPACK research results.

In general, it can be seen from Figure 4 that the percentage of overall competency scores for PGMI STAI Ma'had Aly Al-Hikam Malang Study Program students shows good results. In several aspects, students are in the medium, even high category. Nobody got the low category. Competence in aspects Technological Knowledge (TK) has the highest percentage among competencies Pedagogical Knowledge (PK) and Content Knowledge (CK). The difference in kindergarten aspects between the medium and high value categories reached an accumulation of 54.6%, tending to be more in the high category. Then in the PK aspect, the difference between the medium and high value categories reached an accumulation of 9%, slightly more inclined towards the medium category. Meanwhile for the CK aspect, the difference between the medium and high value categories reached an accumulation of 18.2%, tending to be in the high category. This means that knowledge related to integrating technology in learning is superior to pedagogy and materials (Akhwani & Rahayu, 2021)

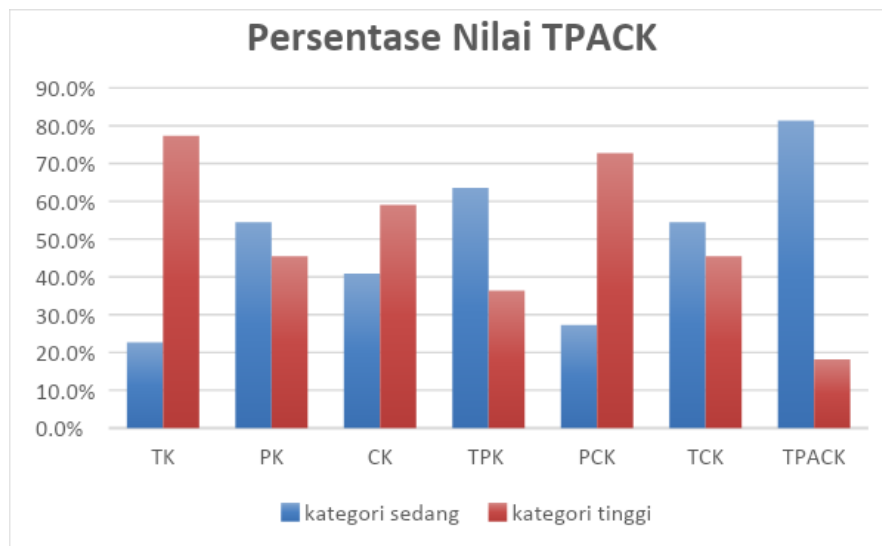


Figure 4. Percentage of TPACK Value

Meanwhile, the components resulting from the intersection of technological knowledge, pedagogy and content show results that are not much different. Aspect Pedagogical Content Knowledge (PCK) has the highest percentage among Technological Content Knowledge from (TCK) Technological Pedagogical Knowledge (TPK). The difference in PCK aspects between the medium and high value categories reached an accumulation of 45.4%, tending to be more in the high category. Then in the TCK aspect, the difference between the medium and high value categories reaches an accumulation of 9%, slightly more inclined towards the medium category. Meanwhile, for the ROR aspect, the difference between the medium and high value categories reached an accumulation of 27.2%, tending to be mostly in the medium category. Different conditions arise when the three main components (technology, pedagogy and content) are integrated. The TPACK aspect has the greatest difference between the medium and high value categories, reaching an accumulation of 63.6%, tending to be more in the medium category. Some of the findings from each aspect are described as follows,

The first aspect, Technological Knowledge (TK) expresses technological knowledge

which refers to simple technology such as pencils, paper and whiteboards to digital technology such as the internet, digital-based videos, software and hardware as well as other digital media (Schmidt et al., 2009). The indicators used in the kindergarten aspect are knowledge about various types of technology, hardware and software and skills in using technology. Findings on the kindergarten aspect show that respondents who are madrasah ibtidaiyah teacher education students are able to use technology in learning. Some of them are even very good at using various hardware such as laptops/computers, cellphones/tablets, and various types of software. In general, students also have the skills to use technology in learning. Thus, this is one of the basic abilities that is demanded by teachers in the 21st century. According to Valtonen et al., (2017) students need to experiment with technology during their teacher education in order to improve their ability to design technology-based learning media. Through good mastery of technology, a teacher is expected to be able to present interesting, creative and motivating learning to students (Nasution, 2018).

The second aspect, Pedagogical Knowledge (PK) refers to learning methods and processes which include planning, management, learning, development and evaluation (Mishra & Koehler, 2008). The indicators used in the PK aspect are planning learning activities and learning evaluation. The findings on the PK aspect show that respondents who are madrasah ibtidaiyah teacher education students have quite good pedagogical abilities. Respondents have gained some theoretical understanding through courses in learning evaluation, learning planning and even student development which can be used as a reference for structuring learning. The better the students' pedagogical abilities, the better the students' readiness to become teachers (Perdani & Andayani, 2021). Therefore, studying learning theories is very important for teachers to have variations in learning that can be adapted to student needs and material (Candra et al., 2020). Overall, these findings are comparable to research by Rahmadi (2019) which stated that the results of prospective teachers' PK abilities were in the good category, including the ability to adapt learning to student characteristics, understanding, and the possibility of misconceptions.

The third aspect, Content Knowledge (CK) indicates knowledge related to the content taught to students. Teachers must master the material they will teach (Mishra & Koehler, 2006) because this ability determines the unique way of thinking of a scientific discipline in each lesson. The indicators used in the CK aspect are mastery of the content of the material being taught and the teaching materials. The findings on the CK aspect show that respondents who are madrasah ibtidaiyah teacher education students have been able to equip themselves before entering the classroom with an understanding of theories, concepts and examples of questions related to everyday life so that students will more easily understand the teaching material well at any time. meeting. Prospective teachers' understanding of the material is very essential because it is related to the depth and delivery of the material to students (Ammade et al., 2020). It would be good for prospective teachers, in this case teacher education students, to utilize various sources in the process of creating teaching materials (Murtiyasa & Atikah, 2021). According to Malichatin (2019), if teachers only use handbooks as the only source of information in creating material, they will experience difficulties in explaining the material and providing the latest information.

The fourth aspect, Technological Pedagogical Knowledge (TPK) reveals knowledge regarding the use of various technologies in teaching. This ability represents the link between technological and pedagogical knowledge (Malichatin, 2019). The indicators used in the TPK aspect are technology-based learning design and the ability to use technological tools and

resources. Findings on the TPK aspect show that respondents who are madrasah ibtidaiyah teacher education students are quite capable of utilizing technology well in the learning process. Selection of appropriate technology based on learning approaches and strategies can build students' knowledge representation. In line with research (Arbianto et al., 2018) which states that students can use technology to interact with students and even adapt it to learning activities. Guan & Wang (2019) found that TPK directly influences how well students learn and how well they master knowledge. Some of these findings state that teachers need to increase the level of TPK abilities so that the learning process runs effectively and efficiently (Zulhazlinda et al., 2023).

The fifth aspect, Pedagogical Content Knowledge (PCK) focuses more on what approach the teacher will choose for the teaching process and the importance of knowing how content elements can be arranged for good learning (Mishra & Koehler, 2006). This knowledge is very important for teachers because each teaching material has its own characteristics so it is necessary to use appropriate teaching methods in each lesson. The indicators used in the PCK aspect are the ability to manage learning content and dialogic learning. Findings on the PCK aspect show that respondents who are madrasah ibtidaiyah teacher education students understand and are able to practice PCK skills in the learning process. These results are comparable to research by Sukaesih et al., (2017) which found that teachers who know how to choose approaches or methods to deliver certain material or content in learning have good PCK abilities. Teachers who are able to adapt learning approaches and strategies to the material being taught will find it very easy to reflect on learning to respond to students' learning difficulties. Over time, prospective teachers' pedagogical content competencies may also increase. A person is not only influenced by academic ability but can also be influenced by the experience and training they have attended in terms of professionalism and teaching skills (Maryono, 2016).

The sixth aspect, Technological Content Knowledge (TCK) leads to knowledge about how to use technology to create content in different ways without considering teaching (Chai et al., 2013). The use of technology will influence how someone can provide an overview of content in a different way than before. The indicators used in the TCK aspect are the integration of technology with learning material and the selection of appropriate technology. The findings on the TCK aspect show that respondents who are madrasah ibtidaiyah teacher education students are quite capable of making good use of technology as a tool in delivering material. This ability can be developed supported by an understanding of theory through the courses they have taken, namely Development of MI Teaching Materials and Learning Media. Based on research by Fuada et al., (2020) that TCK abilities are influenced by the type of courses they have studied. Both can be oriented towards self-actualization to be creative in creating multimedia systematically. According to Cox (2008) TCK is not only an understanding of how technology can be used to describe content, but also how technology can change or even produce content. This requires more than just understanding the concept, teachers must also have the ability to package the material in a simpler way (Yanti & Mawarwati, 2023).

The last aspect, Technological Pedagogical and Content Knowledge (TPACK) or a combination of technological knowledge, pedagogy and material content. TPACK not only understands technology, pedagogy, and content separately but rather as an emergent form and understands how this knowledge interacts with each other (Nasar & Daud, 2020). The indicators used in the TPACK aspect are knowledge about content, pedagogy and technology that are integrated into 21st century digital teaching and learning. The findings on the TPACK

aspect show that respondents who are madrasah ibtidaiyah teacher education students seem to have quite difficulty in integrating the three components in learning. Compared with the other six components, three separate components (TK, PK, CK) and three slice components (PCK, TCK, TPK) in the TPACK aspect have the widest difference between the medium and high value categories. Of the 22 respondents, only 4 were in the high category while the other 18 were in the medium category. This finding is similar to research (Akhwani & Rahayu, 2021) which states that teacher ability gets the lowest score when the components of technology, pedagogy and content knowledge are integrated. While TPACK is considered transformative, the growth of components such as TK or PK does not automatically result in good TPACK (Angeli et al., 2016). This means that good knowledge and focus on kindergarten does not directly translate into having good abilities in integrating TPACK. Thus, there needs to be more strengthening of teacher knowledge in integrating the three related components. Good TPACK skills can be obtained by practicing and learning to utilize and design the latest learning media that is suitable for the material and objectives of a lesson (Nevrita et al., 2020). Because teachers who master TPACK can teach material using appropriate methods and technology.

4. Conclusion

Based on the results of research that has been carried out to determine the level of competency Technological Pedagogical and Content Knowledge (TPACK) students of the Madrasah Ibtidaiyah Teacher Education Study Program (PGMI) Ma'had Aly Al-Hikam Islamic College (STAI) Malang showed good results with detailed aspects Technological Knowledge (TK), Content Knowledge (CK) and Pedagogical Content Knowledge (PCK) is categorized as high while aspect Pedagogical Knowledge (PK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK) is categorized as medium. This research provides a comprehensive overview of aspects of TK, PK, CK and the intersection of TCK, PCK, TPK which gives different results when all components are combined in the form of TPACK. Students need to practice and learn to utilize technology in learning with appropriate material and objectives so that it becomes an alternative effort to improve their TPACK competency. The use of technology must also be supported by accessibility and availability of facilities. This is the government's effort to equalize educational support facilities throughout Indonesia so that the integration of TPACK in learning becomes more adaptive and innovative.

Furthermore, based on the results of this research, it is hoped that there will be further research that examines it in more depth, including the relationship between components, difficulties in implementing and efforts to develop TPACK skills for madrasah ibtidaiyah teacher education students in order to create the embryo of professional teachers. Apart from that, a large number of respondents will increase the quality of research results.

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