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Analysis Technological Pedagogical and Content Knowledge (TPACK) of Physics Teachers at MAN in Palu City during the Covid-19 Pandemic

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Abstract

The purpose of the research was carried out to analyze the technological pedagogical and content knowledge (TPACK) of Physics Teachers at MAN in Palu City during the Covid-19 pandemic. The type of research used is survey research with a descriptive quantitative approach. The sample of this research is a class X MAN physics teacher in the city of Palu. The instrument was developed from previous research which has high validity and reliability. Data collection using questionnaires and interviews. Data analysis used the descriptive statistics test. The results showed that the ability of the TPACK components: pedagogical knowledge (PK) was 79.83; content knowledge (CK) of 68.83; technological knowledge (TK) of 70.00; pedagogical content knowledge (PCK) of 80.56; technological content knowledge (TCK) of 92.50; technological pedagogical knowledge (TPK) of 94.83; and technological pedagogical and content knowledge (TPACK) of 79.17. The average ability of the TPACK component of 80.82 is in the good category.

Keywords: TPACK, physics teacher, covid-19.

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Introduction

The development of digital technology has significantly influenced the world of education. Currently, the use of technology in learning has become an integral part of the school curriculum. The main objective is to improve the ability and quality of learning, as well as develop 21st-century skills in students. In integrating technology into learning, teachers need to understand the concept of TPACK (Technological Pedagogical Content Knowledge) well. The integration of TPACK (Technological Pedagogical Content Knowledge) learning in technological developments has an important role in preparing teachers and students to face the challenges of education in the digital era.

TPACK is a framework that combines three main components, namely technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK), which interact and support each other. By combining these three elements, teachers can design interesting, relevant, and effective learning experiences using technology. TPACK is something framework that integrates knowledge technology, knowledge pedagogy, and knowledge content field studies (Koehler et al., 2013).

Content knowledge (CK) is knowledge about three necessary discussions studied or taught. Knowledge and properties are very different investigations between fields and important for teachers to understand components of more knowledge from the discipline that the teacher teaches. Pedagogical Knowledge (PK) is an in-depth knowledge of the process and practices or methods of teaching and learning that include educational goals, values, and goals (Van Driel, 2002).

Pedagogical Content Knowledge (PCK) is similar to idea knowledge prevailing pedagogy for teaching content certain. The core conceptualization of PCK is idea transformation material lessons for teaching. Technological Knowledge (TK) is knowledge about technology standards, notebooks, chalk writing and board writing, and more technology advances, such as the internet and digital video. this involves the required skills for operating technology. Technological Content Knowledge (TCK) is understanding standard technology and content that influence and limit each other (Koehler et al., 2013).

Technological pedagogical knowledge (TPK) is understanding How teaching and learning can change the moment technology certain used with method. technological pedagogical and content knowledge (TPACK) is a form of knowledge that goes beyond the three components (content, pedagogy, and technology). This knowledge differs from discipline-specific knowledge or technology but also from pedagogical and cross-disciplinary knowledge possessed by teachers (Koehler et al., 2013).

Application technology in the learning process at madrasah aliyah is necessary to package an interesting and interactive learning model for students who need expertise, skills as well as knowledge special for a teacher or educator, no enough only material (Content), or ability to design learning (Pedagogical) but must capable combine technology, pedagogy, and content material learning in carry out so-called learning with TPACK. The importance of knowledge technology is also disclosed in a study (Surif et al, 2014) that most teachers are aware of application technology in the process of teaching and learning science felt Enough important, however, integration of technology in the process is still categorized as simple.

TPACK framework is A contribution important for educating participants on educate use of framework technology inside class. Based on the explanation that has been given according to a number of experts above, then can concluded that TPACK is knowledge about how existing technology can used to support the learning process.

Research results Alqurashi et al. (2017), based on experience teaching and rate education show that teachers in the United States rank more knowledge _ tall in CK and PK, while teachers from Saudi Arabia have more TK, TCK, TPK, and TPCK tall than teachers in the United States. The results of the study (Fajero, et al, 2021) show that the implementation of online learning at State Senior High Schools in the City of Tegal based on the TPACK framework has been carried out well and is proven through the percentage obtained at 69.02% with details on the Technological Knowledge component of 68.42%, the Pedagogical Knowledge component of 66 .66%, the Content Knowledge component is 66.86%, the Technological Content Knowledge component is 72.88%, the Pedagogical Content knowledge component is 67.69% and the Technological Pedagogical knowledge component is 71.63%. The results of the study (Gunanto & Supriyadi, 2021) TPACK component of pre-service teachers during five meetings of physics, was able to use technology to guide students well. The disadvantage of pre-service teachers which are still low is the content knowledge components and need to be improved before becoming a professional teacher, so the teacher can integrate learning using technology properly. The following is previous research on TPACK analysis on high school biology and chemistry material as a comparison to TPACK Physics analysis.

Based on the results of the study Widiana (2022) it can be concluded that overall the TPACK competencies of the five biology teachers are in the pre-, growing, and maturing categories. Biology teachers experience difficulties in integrating appropriate content of knowledge, pedagogy, and technology in teaching viral material in applying it in everyday life. To overcome this, coaching or training is needed to improve the TPACK competence of biology teachers in teaching virus material. The results of the study (Triwahyudi, et al., 2021) stated that 57.6% of students had difficulty understanding concepts and 72.7% had difficulty working on the questions given. The survey results also say that all students need to develop learning tools that integrate TPACK to achieve learning goals. For this reason, it is necessary to develop TPACK-based learning tools on chemistry material. research results (Kaharudin, 2021) Implementation of Online Learning in Science lessons with the TPACK approach by implementing ICT and Android Technology has a positive impact on increasing student competence in terms of attitudes, knowledge, and skills.

The role of the teacher in using technology in learning is very important. Apart from being a teacher, the teacher must also be able to become a facilitator, manager, and guide for students. They must be able to create interesting learning experiences and make it easier for students to understand the material. By packaging learning experiences in an interesting way, teachers can motivate students to be more active and participate in the learning process. Through the use of technology in learning, students are expected to be able to develop 21st-century skills such as problem-solving, creativity, collaboration, and digital literacy. The teacher's task is not only to teach lessons but also to package their experience to make it more interesting so that it makes it easier for students to explore learning (Rochintaniawati, et al., 2019).

These skills are critical in preparing students for the challenges of an increasingly connected and rapidly changing world of work. In this context, teachers have a central role in shaping a more competitive society through education. By integrating technology into learning, teachers can help students develop skills and knowledge that are relevant to future needs. In a remote learning situation during the Covid-19 pandemic. Policies taken by many countries including Indonesia dismiss whole activity education, create government and institutions related must presenting alternative educational processes for participants educate nor students who don't carry out the educational process at the institution education (Purwanto et al, 2019).

The spread of covid-19 has given challenge alone for institution education in Indonesia. To anticipate transmission of the virus government emits policies such as social distancing, physical distancing, to restrictions on social scale (PSBB). This condition requires the public to stay at home, study, work, and worship at home. The consequence from policy is the sector education base until education is tall stop the learning process in a manner stare face. Instead, the learning process is held offline and online as possible from each student's home. Following the letter circular Ministry of Education and Culture number: 36962/MPK.A/HK/2020 about learning to go online and work from home to prevent the spread of covid-19.

Government province Sulawesi Middle decided to allow learning in a manner that advances on all unit education levels until education that height is in the province Central Sulawesi, especially in Palu city. Learning process online /online or offline/ module This will apply during odd semesters year lessons 2020/2021 and get reviewed return by developments and policies regarding government-related deployment of the covid-19 pandemic nationally (Dikbudsulteng, 2020).

Policy implementing school method online learning requires skills in the science and technology field. Lack of teacher's ability to master science and technology will affect the quality of applied online learning (Festiawan, 2020; Sudrajat, 2020; Rosenberg & Koehler, 2015) mentions that in realizing quality learning needs framework work to develop technology, pedagogy, and materials learning. There are several models of approaches that can be used in online learning including LMS, MOOC, Micro Learning, and TPACK.

TPACK is knowledge and skills in integrating technology into learning (Suyamto et al. 2020). In line with the explanation (Rahayu, 2017) mentioned that TPACK is the necessary knowledge for integrating technology into the learning process. The professionalism inherent in the teacher obliges mastery in a manner theoretical and practical organizing between technology, pedagogy, and content learning.

Based on previous studies, it appears that the research that has been conducted has not involved a thorough assessment of the TPACK abilities of Physics teachers in Palu city. It is important to conduct research that examines the extent to which Physics teachers master and ability to apply TPACK in the learning process carried out in schools, especially in the midst of the Covid-19 pandemic. Therefore, an in-depth study of Technology Pedagogy Analysis and Content Knowledge (TPACK) is needed from Physics teachers at MAN in Palu City during the Covid-19 pandemic.

Methods

The research was conducted at the State Aliyah Madrasah in Palu City, namely: MAN 1 Palu City, MAN 2 Palu City, and MAN Insan Cendikia City Palu. The sample of this study were all physics teachers who taught in class X MAN 1 Palu City, MAN 2 Palu City, and MAN Insan Cendikia Palu City, totaling 6 people who were given the Respondent's initials (R1-R6).

Based on the demographics of the research respondents, there were 5 female respondents, 1 male respondent, 4 undergraduate,

and 2 S2 educational backgrounds, 4 respondents with 1-5 years of experience and 4 years of teaching experience over 5 years.

Data collection techniques in research carried out with 3 stages of study as follows: The first is the planning stage, at this stage, the researcher searches for literature and makes initial observations (direct observation). This observation is used to determine the objective condition of the physics teacher. Then, researchers used several instruments to obtain the data needed in this study. explained that testing the validity of one of the instruments can be done by testing the construct validity, namely the instrument test which is carried out using experts or commonly called expert judgment.

In the second stage, the researcher gave a test in the form of a modified questionnaire referring to the research instrument

Results data teacher's TPACK mastery was analyzed in a manner statistics descriptive through the SPSS version 25 program. On the instrument test, observation, and

$$p=f/N\times100$$

Description:

p= Mark

f= Score obtained

N= Maximum score

the value obtained then compared with criteria interpretation to determine the teacher's TPACK category (Sugiyono, 2013).

Results and Discussion

The research results have been analyzed using descriptive statistics, and formulas and described based on the TPACK criteria as follows

Analysis of the PK, CK, and TK ability of physics teachers in this study obtained research data as shown in Table 1, Analysis of the PCK, TCK, TPK, and TPACK ability of physics teachers in this study obtained research data as shown in Table 2.

Based on the research that has been done, the average value of the TPACK component is obtained as shown in Table 3 below.

Ability Pedagogical Knowledge (PK) physics teacher based on Table 1 can is known in the Good Category. PK contains teacher knowledge from management classes, assignments, planning, as well learning. In matter, this is a physics teacher's level of good knowledge about pedagogics. There is a resemblance results in Deep PK ability research (Hidayati, et al, 2019) studied ie evaluation of students, approach teaching, management class, customization style Study with student obtained results Pedagogical Knowledge (PK) in Good Category. Based on description ability the PK component of the result shows that teacher pedagogy in the study is in the Good Category.

Content knowledge (CK) abilities of physics teachers based on Table 1 can be known that the average physics teacher's CK ability is a good category. There is a resemblance results in Content knowledge (CK) skills in research (Supriyadi, et al., 2018) ability master material student physics especially in draft motion straight Still counted Good. Based on description ability the CK component of the result shows that knowledge teacher content in the study is in the good category. Ability Technology Knowledge (TK) Based on Table 1 can is known that the average ability of a kindergarten physics teacher is Good Category. There is a resemblance with the results study (Zulfitria, 2020) that height TK components are compared with components else on the effect the Covid-19 pandemic requires the use of technology and deep internet learning, so teacher skills in the field technology increase.

(Desstya, 2018) which had been tested for validity and reliability. The test used to measure PK ability consists of 30 questions, and CK consists of 15 questions, in the form of multiple choices. TK totaled 15 items, PCK totaled 18 items, TCK totaled 18 items, TPK totaled 9 items, and TPACK totaled 20 items to physics teachers by keeping a distance according to health protocols because the research was conducted during the Covid-19 pandemic.

In the last stage at this stage, the researcher conducted interviews to obtain in-depth information about the Technological Pedagogical and Content Knowledge (TPACK) abilities of the respondents using an interview guide totaling 11 questions.

questionnaire, the total score has been obtained and converted become value. The maximum value obtained is 100 counted with formula as follows:

Based on Pedagogical Content Knowledge (PCK) ability Table 2 can is known that the average PCK abilities of physics teachers for all respondents are within a good category. Similar results were found by (Decoito & Richardson, 2011) which shows that the teacher has own good attitude and knowledge about pedagogy and integration technology in learning, however, real learning in class shows the teacher is not capable of applying his knowledge to create ICT integrated learning.

Technology Content Knowledge (TCK) capability based on Table 2 shows that the average TCK ability of physics teachers is a very good category. this result is equivalent to research conducted by Restiana and Pujiastuti (2019) which shows that TK and CK components have an effect positive to perceptions of teacher PCK.

Ability Based on Technological Pedagogical Knowledge (TPK). Table 2 shows that the average TPK ability of physics teachers is in the very good category. This result is equivalent to the results study (Neumann, et al., 2019) which shows that there is a positive and significant relationship between TK and TPK with high value. this result is equivalent to research conducted by (Akhwani, 2021) on components that have mark highest average namely Technological Pedagogical Knowledge (TPK). Teacher capabilities in the TPK component include the ability to adapt technology to activities and different learning and, the ability to think critically about the use of technology in class.

Ability based on technological pedagogical and content knowledge (TPACK). Table 2 shows that the average TPACK ability of physics teachers is a good category. There is a resemblance results TPACK ability of teachers who are in the good category and with the results of the research (Ariani, 2015; Wahyuni & Pratiwi, 2019). The top rate from the seventh component is the mark contained in the component Technological Pedagogical Knowledge (TPK). It means integrating technology and teacher pedagogy knowing the benefit of technology that can be used in appropriate teaching to support teaching strategies Good it's a model, method, or learning media in the classroom. meanwhile, the mark Lowest from the seventh component the contained in the component technological knowledge (CK). However Still in the Good Category.

Table 1. PK, CK and TK ability value

N	PK				CK				TK			
	Score	Max Score	Value (xi)	Category	Score	Max Score	Value (xi)	Category	Score	Max Score	Value (xi)	Category
R 1	27	30	90	VG	10	15	67	GE	14	20	70	G
R 2	27	30	90	VG	15	15	100	VG	14	20	70	G
R 3	13	30	43	LG	5	15	33	NG	13	20	65	GE
R 4	22	30	73	G	8	15	53	GE	12	20	60	GE
R 5	28	30	93	VG	12	15	80	G	16	20	80	G
R 6	27	30	90	VG	12	15	80	G	15	20	75	G

Table 2. PCK, TCK, TPK and TPACK ability value

N	PCK				TCK				TPK				TPACK			
	Score	Max Score	Value (xi)	Category	Score	Max Score	Value (xi)	Category	Score	Max Score	Value (xi)	Category	Score	Max Score	Value (xi)	Category
R 1	15	18	83	VG	10	11	91	VG	9	9	100	VG	15	20	75	G
R 2	15	18	83	VG	10	11	91	VG	9	9	100	VG	18	20	90	VG
R 3	14	18	78	G	10	11	91	VG	9	9	91	VG	13	20	65	GE
R 4	12	18	67	GE	9	11	82	VG	8	9	89	VG	12	20	60	GE
R 5	15	18	83	VG	11	11	100	VG	8	9	89	VG	20	20	100	VG
R 6	16	18	89	VG	11	11	100	VG	9	9	100	VG	17	20	85	VG

Physics teacher TPACK skills can also affected by the level of support technology available in schools and by resources power that can accessed by physics teachers, such as enough internet access and devices. However, with experience and time, many physics teachers can increase their TPACK capabilities in teaching online. Many physics teachers have to use technology with creative and effective ways to increase the experience of Study students during the covid-19 pandemic.

Covid-19 pandemic has forced physics teachers to switch to learning distance. This possibly influences the TPACK ability of physics teachers Because they must Study methods using technology and learning platforms distance Far with fast and effectively. With so, the conclusion about the TPACK abilities of physics teachers during the Covid-19 pandemic will depend on a variety of factors, including the level of support available technology, sources available resources, and the efforts made by the physics teacher to increase their ability.

Conclusions

TPACK ability of physics teachers class X MAN in the Palu city during the pandemic covid-19 with PK details on categories well, CK on category well, TK on category well, PCK on Good Category, TCK in very good category, TPK in very good category, and TPACK in Good Category. TPACK ability of physics teachers class X at MAN in the Palu city during the Covid-19 pandemic was classified well, with a number of category such as excellent TCK and TPK. This shows that the physics teacher at MAN in the Palu city own ability powerful and capable technology blend technology with teaching and content in a manner effective.

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Conflicts of Interest

All authors declare that they have no conflicts of interest.

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