ANALYSIS OF TECHNOLOGYCAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) CONTENT OF SCIENCE LEARNING IN ELEMENTARY SCHOOL LEARNING PLANS

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Abstract. This study aims to analyze the Learning Implementation Plan (RPP) using the Technological Pedagogical Content Knowledge (TPACK) approach. This research uses a qualitative approach with the method of library research (library research). The source of the data used is primary, which means the lesson plans are designed directly by prospective educators of Muhammadiyah University Surakarta students in the 6th semester. The data used to analyze a total of 6 lesson plans consisting of grades IV and V of Elementary School. The analysis in this study uses 7 aspects with 17 indicators. The results of the study show that the understanding of prospective teachers in designing Learning Implementation Plans (RPP) is very good and optimal. The data shows an analysis of 100% TK, 95.8% PK, 100% CK, 100% TPK, 100% TCK, 87.5% PCK, 100% TPACK. The value data shows that it is included in the very good criteria.

Keywords: technological pedagogical content knowledge, science, RPP, elementary school.

INTRODUCTION

Technological Pedagogical Content Knowledge (TPACK) is a form of knowledge that has 3 components namely content, pedagogy, and technology that must be integrated by an educator to in the 21st century effectively (Nofrion et al, 2020). In this era, technology has developed very rapidly, meaning that it is a demand for a teacher to master technology so that students can easily accept material during learning. This is in line with the Technological Pedagogical Content Knowledge (TPACK) approach, that TPACK is optimizing Kindergarten used in learning to implement CK, PK, and PCK so as to produce a complete and perfect learning process so as to create Indonesian education that can compete in the industrial revolution era 4.0

Research conducted by Tommy et al (2020: 107) states that the teacher's TPACK level is at a modest level with a range of values of $3.21 < x < 4.11$. This research indicates that the teacher's TPACK competency is not optimal. The two studies above have not explicitly classified the intersection between each component and its comparison with TPACK as a whole. This was also explained in Anatri Desstya's research (2018) that there is an 85.6% certainty of item consistency in producing data that is more or less the same repeatedly. So it is said that the TPACK instrument has high reliability.

Science learning in elementary schools is the initial basis for forming students who have scientific knowledge, skills and attitudes (Purniadi Putra, 2017). In this case, of course, it is closely related to the Technological Pedagogical Content Knowledge (TPACK) approach, elementary school teachers in Indonesia must integrate TPACK in science learning because it can help determine the influence of developing teacher professionalism. That is the importance of TPACK to the quality of education in Indonesia. As according to (Desstya, 2018) which states that TPACK is used as a guide in improving the quality of education.

The TPACK model is very suitable to be applied to further study the ability of teachers in the learning process, especially in Indonesia. TPACK is part of the competence of Indonesian professional teachers listed in the Academic Qualification Standards and Teacher Competency in Indonesia (Yulisman, 2019). The TPACK ability of elementary school teachers, especially in thematic learning, needs to be measured in order to find out the extent to which educators understand and implement the use of technology in accordance with the material to be taught through learning methods and tactics. In studying further, of course, special evidence is needed, one of which is through the analysis of the Learning Implementation Plan (RPP) (Syaifuddin, 2017).

Learning Implementation Plans (RPP) are guidelines in learning activities that must be owned by every teacher. The better the teacher's mastery of TPACK, the better the quality of the lesson plans produced. Thus the learning objectives can be achieved. Based on Sholihah's research (2016) if the teacher has a quality TPACK, then the teacher is also able to develop it in designing a good lesson plan as well. Therefore, researchers feel compelled to conduct special research regarding the TPACK analysis of science content in Elementary School Learning Implementation Plans (RPP).

RESEARCH METHOD

This study used a qualitative approach with a library research design. The data used to analyze is 6 lesson plans consisting of grades IV and V of Elementary School (SD). The analysis in this study uses 7 aspects including Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge TPK, Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Content Knowledge (TPACK) with 17 indicators, each of which is divided into 7 aspects. The data source for this research is a primary data source, meaning that the data obtained is the lesson plan that was designed directly by prospective teacher educators at the Muhammadiyah University of Surakarta semester 6 in class IV and class V of elementary school. The data collection technique used was in the form of 6 lesson plans complete with learning tools compiled by PGSD FKIP Muhammadiyah University Surakarta students in semester 6. The data analysis technique used in qualitative analysis has four stages, namely data collection, data reduction, data presentation, and the final step is withdrawal. conclusion and verification. The validity of the data used by researchers is that researchers use triangulation. The triangulation used was to check or as a comparison against the data we got, namely the 6th semester teacher of the Elementary Mathematics and Natural Sciences curriculum study subject (Dr. Anatri Desstya, ST, M.Pd.).

RESULT AND ANALYSIS

The TPACK component analysis is grouped into 7 domains, namely Technological Knowledge, Pedagogical Knowledge, Content Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, Technological Pedagogical and Content Knowledge. Based on the results of the analysis carried out, data were obtained from 6 lesson plans. The lesson plans that were analyzed were class 4 and class 5. The results obtained from this study were to analyze the TPACK of science lesson content in lesson plans, TPACK there are 7 components. Furthermore, each aspect is analyzed according to the indicators in the following table.

1.1. Instruments TPACK

Instrument consists of 6 lesson plans that have been analyzed according to the 7 components of Technological Pedagogical Content Knowledge (TPACK) y ang there are 2 to 3 indicators each, then a score is obtained according to the following indicators.

Table 1. Instruments for measuring TPACK

Aspects that are expected to appear	Indicators	SCORE			
		4	3	2	1
Technological Knowledge (can determine technology (ICT and non-ICT) and its functions for teaching material	1. Able to determine ICT technology and its functions 2. Determine non-ICT technologies and their functions	There are all descriptors	There are most of the descriptors	There are some descriptors	There are a few descriptors
Pedagogical Knowledge (teachers are able to organize classes that are managed through various methods, strategies, and learning models)	1. There is a scientific approach 2. There is a learning model that fits the material 3. There are learning methods or strategies that fit the model, approach , and material	There are all descriptors	There are most of the descriptors	There are some descriptors	There are a few descriptors

Content Knowledge (menentukan materi dan menjelaskan konsep-konsep materi yang akan dibelajarkan kepada peserta didik)	1. Determining science materials y which corresponds to KD. 2. Able to explain the concepts of science material	There are all descriptors	There are most of the descriptors deskriptor	There are some descriptors	There are a few descriptors deskriptor
Pedagogical Content Knowledge (understanding the orientation of science teaching; understanding teaching strategies; conducting evaluations	1. Determining the orientation of teaching science; 2. Determining teaching strategies according to science material. 3. Doing evaluation 4. Design lesson plans	There are all descriptors	There are most of the descriptors deskriptor	There are some descriptors	There are a few descriptors deskriptor

Technological Content Knowledge (able to determine ICT and non-ICT technology that can be used to help convey science concepts)	1. Suitability of ICT technology used to teach science material 2. Suitability non-ICT technology used to teach science material	There are all descriptors	There are most of the descriptors deskriptor	There are some descriptors	There are a few descriptors deskriptor
Technological Pedagogical Knowledge Teachers understand technology ogi (ICT and non-ICT) and their functions, which can be used to organize classes, which starts at the planning stage so that the implementation process goes well.	1. There is ICT technology that is applied in certain learning models, approaches or strategie 2. There are non-ICT technologies that are applied in certain learning models, approaches or strategies	There are all descriptors	There are most of the descriptors deskriptor	There are some descriptors	There are a few descriptors deskriptor

Technological Pedagogical and Content Knowledge integrating technology (ICT and non-ICT) in teaching science material	1. There is ICT technology that is integrated by teachers when teaching Science material with certain approaches, models, methods or learning strategies. 2. There are non-ICT technologies that are integrated by teachers when teaching Science material with approaches, models, methods , or certain learning strategies	There are all descriptors	There are most of the descriptors deskriptor	There are some descriptors	here are a few descriptors deskriptor

1.2. Aspect of TPACK

Table 1.2 Aspect of TPACK

Aspects that are expected	**RPP ke-**					
	(I) SCORE	**(II) SCORE**	**(III) SCORE**	**IV SCORE**	**V SCORE**	**VI SCORE**
Technological Knowledge (TK)						
Pedagogical Knowledge (PK)						
Content Knowledge						

Aspects that are expected	RPP ke-					
	(I) SCORE	(II) SCORE	(III) SCORE	IV SCORE	V SCORE	VI SCORE
(CK)						
Technological Pedagogical Knowledge (TPK)						
Technological Content Knowledge (TCK)						
Pedagogical Content Knowledge (PCK)						
Technological Pedagogical and Content Knowledge (TPACK)						
Jumlah SKOR	26	28	26	27	28	27
Nilai TPACK rata -rata	92,8	100	92,8	96,4	100	96,4

The formula used to convert the scores obtained into percentages is as follows.

$$\frac{\text{total TPACK scores analyzed}}{total\ TPACK\ scores} x100$$

Value =

To measure teacher abilities based on the TPACK component, the criteria for following the Likert scale have been compiled by Anggara (2018) as follows.

Table 1.3. Criteria for TPACK Level

Score	Criteria
84,01 – 100	Very good
68,01 – 84,00	Good
52,01 – 68,00	Adequate
36,01 – 52,00	Poor
20,00 – 36,00	Very poor

(Anggara, 2018)

From the 6 RPPs analyzed, the results of the TPACK components were obtained as follows.

1.2.1. Technological Knowledge

Based on the results of the RPP that have been analyzed, namely RPP I, RPP II, RPP III, RPP IV, RPP V, and RPP VI, there is already Technology Knowledge (TK) content because it already includes ICT-based and non-ICT-based technologies. ICT technology is demonstrated when teachers use applications such as WhatsApp, Google meet, YouTube, and Google forms. Then broadcast power point media as a teacher's tool to explain learning material. While Non-ICT is shown to students who are instructed to make observations and experimental experiments.

1.2.2. Pedagogical Knowledge (PK)

Based on the results of the analysis of RPP I, RPP II, RPP III, RPP IV, and RPP V, the 5M scientific approach has been included. It's just that RPP VI uses the 5E approach (Engagement, exploration, explanation, elaboration, evaluation). Learning models are used with various models, including lesson plan I, lesson plan II, namely PBL, lesson plan III uses the SETS model, lesson plan IV uses an interactive learning model, lesson plan V uses the inquiry learning model, and lesson plan VI uses the learning cycle learning model. Whereas the learning methods used in lesson plans 1, lesson plans II, lesson plans II, and lesson plans IV are lectures, questions and answers, discussions, assignments, practices. Whereas in RPP V and RPP VI using lecture, question and answer, assignment, and experiment learning methods. For RPP V the experiment was in the form of conducting experiments related to various forces, while RPP VI conducted experiments related to the relationship between force and motion.

1.2.3. Content Knowledge (CK)

Based on the analysis results in RPP I, the science material discussed is regarding the forms and functions of plants & animals. The practice carried out in this lesson is observing the structure of corn plants, starting from the roots, stems, leaves, corn, and corn silk. Students are directed to mention the benefits of each part of the plant. Judging from the teaching materials there is material regarding the functions of plants & animals along with supporting pictures. Based on the results of the analysis in RPP II, the learning material discussed was "Respiratory organs in humans". The practice carried out in this lesson is to make experiments on the human respiratory system using materials that are around us. The concept can be seen from the teaching materials that have implemented material explanations along with pictures. Based on the results of the analysis in RPP III, the learning activities contained Content Knowledge, it was seen that the teacher was able to explain material about the parts of plants and students made their own observations in the surrounding environment. The concept of science material can be seen in the teaching materials for the existence of a material and pictures. The results of the analysis of RPP IV, the material presented is in accordance with KD, namely the material for the process of sound occurrence from sound sources and sound properties. Mastery of the teacher's material can also be seen with questions that can stimulate children to understand the material. The concept is contained in teaching materials, namely in the form of science material regarding sound and images. Based on the results of the analysis of RPP V, IPA material according to KD has been listed. The science material discussed is about style. In learning activities there is Content Knowledge marked by the teacher being able to explain style material. The experiments carried out in learning activities are experimenting with various styles. Students are directed to experiment with each style. The

concept of science material is in teaching materials in the form of various styles of material along with pictures. Based on the results of the analysis of RPP VI, there are natural science materials that are in accordance with KD. Experiments carried out in the form of force and motion. The concept of science material is contained in the teaching materials presented by force and motion material along with image explanations.

1.2.4. Technological Pedagogical Knowledge (TPK)

Based on the results of the analysis in lesson plan 1, I have integrated ICT into learning strategies, namely the teacher uses video lessons (videos made by the teacher about plant structures) to motivate students in learning. Based on the results of the analysis in lesson plans II, teachers use learning videos (videos made by teachers about human respiratory organs) to motivate students in learning. Based on the results of the analysis in RPP III, ICT and Non-TIK technology have been implemented, namely in the implementation of teacher learning using Google Meet media. Then the teacher also uses media in the form of showing learning videos about plant parts so that they can be used as material for student discussion to implement the SETS learning model. Whereas for non-ICT it is shown in independent observation activities about plant parts. The results of the RPP IV analysis of the material presented have applied technology by displaying PowerPoint using web meetings (video calls) between students and teachers. In addition, students are also invited to use the WhatsApp application to collect assignments. Based on the results of the analysis of RPP V, ICT and non-ICT have been integrated, namely in the implementation of teacher learning using the Gmeet room media as a medium for teachers to apply a scientific approach. Then the teacher also uses the media in the form of showing video material about force which can be used as material for discussion of students and for carrying out the Inquiry learning model. Meanwhile for non-ticks it is shown in experimental activities regarding the magnetic force found in LKPD. Based on the results of the analysis of RPP VI, there are already typed and non-tick media. In the implementation of teacher learning using Google meet. the media is in the form of viewing video material about trying to pull and push chairs, while the non-tick media that is taught is that students are asked to prove or try pushing and pulling chairs.

1.2.5. Technological Content Knowledge (TCK)

Based on the analysis of TCK content in RPP I, RPP II, RPP III, RPP IV, RPP V, and RPP VI teachers have been able to apply Technological Content Knowledge using ICT and Non-TIK media. ICT media used in lesson plans are learning videos/youtube, power point. While non-tick depends on the learning material. For example, non-ICT examples include pictures of animals, making charts of human respiratory organs, conducting simple experiments regarding the magnetic force found in the worksheet. The tools and materials in the experiment included: a book, 2 magnets, 5 nails, a comb, scraps of paper, and 3 rulers, conducting experiments on pulling and pushing chairs and applying the concepts of force and motion learned in everyday life.

1.2.6. Pedagogical Content Knowledge (PCK)

Based on the results of the PCK analysis in lesson plan I, the teacher has designed the lesson plan and determined the orientation of science teaching using appropriate approaches, models and methods, but has not included science teaching strategies in it, then has carried out an evaluation at the end of the learning activity. Based on the results of the analysis in RPP II, the teacher has designed a lesson plan and determined the orientation of teaching science using appropriate approaches, models and methods, including science teaching strategies in it and an evaluation at the end of the learning activity. Based on the results of the analysis on RPP III, a combination of special abilities from content and pedagogic knowledge that is formed over time and increases in teaching experience. The implementation of this learning is one of the teacher's competencies. In the RPP which consists of CK, PK, and PCK. Based on the results of the analysis in RPP IV, the approach used is a scientific approach which contains 5 scientific methods in the form of 5M (observing, asking, gathering information, associating, and communicating). The learning model is not suitable because RPP IV uses an interactive model with lecture, discussion, question and answer, and assignment learning methods. However, at the core of learning there are no teacher steps to explain to students (lectures), there are only discussions, questions and answers and

assignments. The RPP also includes an evaluation step. Based on the results of the analysis of RPP V, the teacher has implemented a teaching strategy in accordance with natural science material, because in the lesson plan the approach used is a scientific approach which contains 5 scientific methods in the form of 5M. In addition, the learning model uses the inquiry model with lecture, experiment, assignment, and question and answer learning methods that emphasize the process of searching and finding. This is in accordance with the 5M scientific method. In the RPP there is also an evaluation step by which students are asked to work on the questions individually to then be assessed. Based on the analysis on RPP VI, KD and learning steps are appropriate, but the strategy used is not appropriate because it does not use 5M, but uses 5E (Engagement, exploration, explanation, elaboration, evaluation). The learning model used is the learning cycle, while the method used is; discussion lectures, experiments, assignments. In addition, in the RPP there is an evaluation step in which students are asked to work on individual questions for assessment.

1.2.7. Technological Pedagogical and Content Knowledge (TPACK)

Based on the TPACK analysis on RPP I, RPP II, RPP II, RPP, IV, RPP V, and RPP VI which have been analyzed, almost all components are present. TPACK, it's just that the Pedagogical Knowledge (PK) and Pedagogical Content Knowledge sections have not fulfilled all the descriptor components. The lesson plans that were analyzed already mostly have ICT technology integrated by teachers when teaching science material, in the form of YouTube videos with scientific approaches, learning models, as well as lecture, experiment, assignment, and question and answer methods. There is also non-ICT technology that is integrated by the teacher when teaching science material in the form of experiments.

1.3. Discussion TPACK

TPACK is a component framework that introduces the complex relationship between technological knowledge, pedagogy and material content (Farikah et al., 2019). These three components have interactions and relationships between each other. The TPACK concept involves 7 knowledge domains because there are new slices or synthesis, namely: 1) Content Knowledge (CK); 2) Pedagogical Knowledge (PK); 3) Technological Knowledge (TK); 4) Pedagogical Content Knowledge (PCK); 5) Technological Content Knowledge (TCK); 6) Technological Pedagogical Knowledge (TPK); and 7) Technological Pedagogical Content Knowledge (TPACK) (Innaha & Setyaningsih, 2018: 496 – 497).

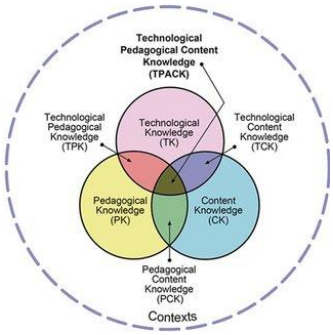


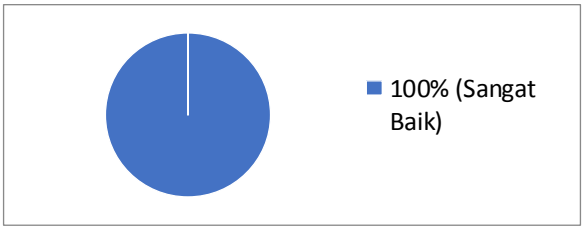
Figure 1. Framework of the TPACK Components

Based on the results of the TPACK analysis in Class IV and V Class Implementation Plans (RPP) it can be seen from each aspect of TPACK.

1.3.1. Technological Knowledge (TK)

Analysis of Technological Knowledge (TK) skills in 6 lesson plans has an average score of 100% in the very good category. According to Sa'adah et al (2018: 20) said that Technological Knowledge (TK) refers to knowledge about technology that can be integrated into curriculum and learning and refers to skills in using it. This can be related to Piaget's theory that elementary school children aged 7-12 years need concrete objects to help apply abstract concepts. The objects that produce this sound are concrete objects where in the lesson plan these objects include: trumpets, bells, surrounding plants, human respiratory organs, force, and motion.

Diagram 1. Technological Knowledge (TK)

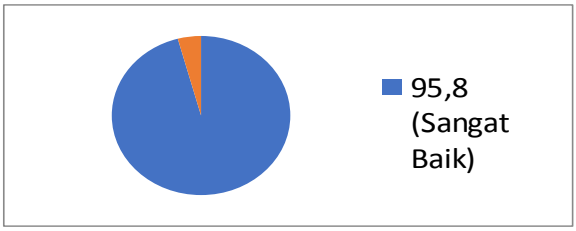


1.3.2. Pedagogical Knowledge (PK)

Based on the results of the analysis, the Pedagogical Knowledge (PK) component in 6 lesson plans has an average score of 95.8% in the very good category. This is as Pedagogical Knowledge (PK) is a set of skills developed by teachers so that they can carry out planned learning processes to achieve the expected learning objectives (Agustini et al, 2019: 3).

Based on data analysis, PK aspects were obtained in class IV and V lesson plans which are presented in the diagram below.

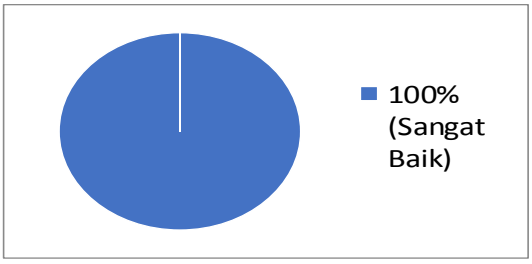
Diagram 2. Pedagogical Knowledge (PK)



1.3.3. Content Knowledge (CK)

Based on the data from the analysis of content knowledge skills in the six lesson plans, an average result of 100% is in the very good category. The results of content knowledge show that they have the ability to master very good material that is taught to students. According to Imam Fitri Rahmadi (2019: 66) Content Knowledge (CK) is a teaching activity based on knowledge of the material to be taught.

Diagram 3. Technological Knowledge (TK)

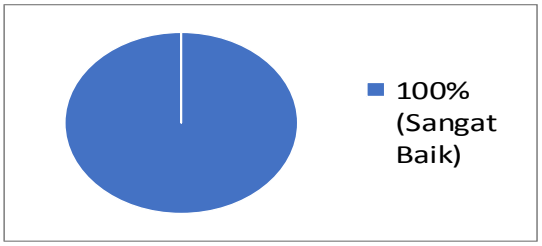


1.3.4. Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge (TPK) is knowledge to understand the use of technology with appropriate learning models in order to achieve the expected learning objectives. With technology, it makes it easier for teachers to find new methods to apply in class (Agustini et al., 2019: 3).

Based on data analysis, the TPK aspect was obtained according to an average score of 100% which is presented in the table below.

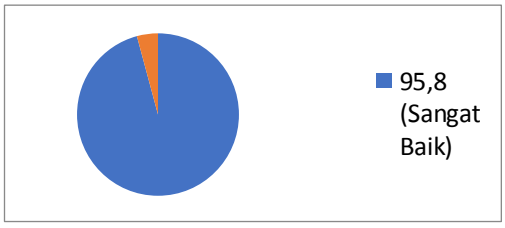
Diagram 4. Technological Pedagogical Knowledge (TPK)



1.3.5. Technological Content Knowledge (TCK)

Based on the results of an analysis of the application of Technological Content Knowledge in the teacher learning process (RPP) it shows that 95.8% of teachers are able to use learning technology such as using technological media such as projectors, laptops, and gadgets. Not only that, the technology used by teachers as learning media includes using ICT Hardware and Software (Internet, Video, Images, laptops, projectors, and gadgets in very good categories.

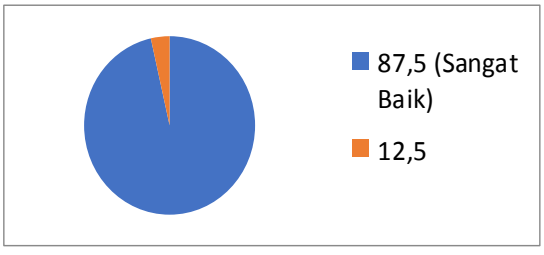
Diagram 5. Technological Content Knowledge



1.3.6. Pedagogical Content Knowledge (PCK)

Based ondataanalysis results the ability of Pedagogical Content Knowledge in six lesson plans obtained an average score of 87.5% in the very good category Hurrel (2019) said that Pedagogical Content Knowledge (PCK) is a combination of content knowledge and pedagogical knowledge that teachers apply in classroom learning by pay attention to the existing context.Based on data analysis, PCK aspects were obtained in lesson plans for grades IV and V which are presented in the diagram below.

Diagram 6. Pedagogical Content Knowledge (PCK)

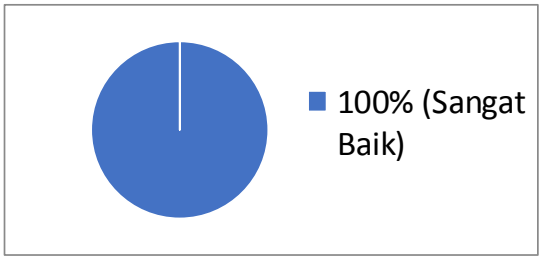


1.3.7. Technological Pedagogical and Content Knowledge (TPACK)

From the research data obtained it can be seen that the average teacher's TPACK score in the learning process to welding IV and V are in very good criteria with a score of 100. The criteria are very good in understanding the characteristics of students so they can choose methods that are supported by technology.

TPACK is a knowledge-based technology that enables teachers to design and implement lessons needed for curriculum content while considering the educational context (Kim & Lee, 2018). TPACK is a combination of technology, pedagogy, and content that is applied according to the context in learning. All of these combinations must be mastered by the teacher. The TPACK framework describes three knowledges coupled with technological elements, namely Technological Knowledge (TK), Technological Content Knowledge (TCK), and Technological Pedagogical (TP). The three knowledge and technology are important for a teacher to have, because they affect how to teach.

Diagram 7. Pedagogical Content Knowledge (PCK)



Based on the results of the six lesson plans, there is a TPACK score in the very good category, so that the 7 components are fulfilled. The teacher's ability in the fields of technology, pedagogy, and material content in RPP I – VI is balanced, the difference is not too high. The highest scores of the six RPPs are found in RPP II and RPP V.

CONCLUSION

The results of the analysis show that the application of TPACK to the Learning Implementation Plan for the majority of the average values reported has very good criteria. different learning. Based on the results of the TPACK analysis on the Learning Implementation Plan carried out by the teacher by integrating learning technology in learning activities. Teachers use learning technology as a reference, learning resource, and learning media. TPACK is designed before carrying out learning activities, teachers try to integrate learning technology by paying attention to the use of strategies that combine pedagogy, technology, and material content.

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