



## **Technological Pedagogical Content Knowledge (TPACK) Teacher in Teaching Geometry in Grade V Elementary School**

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### **Abstract**

*This study aimed to determine the level of Technological Pedagogical Content Knowledge (TPACK) of fifth-grade teachers at Ma'rang District, Pangkep Regency, particularly on geometry. This research uses the descriptive qualitative type of research. The participants were three fifth-grade teachers from SD Negeri 6 Pitue, SD Negeri 13 Padang Lampe, and SD Negeri 20 Alesipitto. These schools were chosen because they were once the targets of the Kampus Mengajar Program, while one of the program's activities was to assist in adapting technology in schools. The data collection used observation and interview techniques. The data analysis consists of data condensation, data presentation, and conclusion. The research results show that the teacher occasionally delivered geometry subject matter using technological devices such as a laptop and projector, as well as the Microsoft PowerPoint application. The use of technological devices and applications in learning was based on teachers' consideration to make the lessons enjoyable and easy to understand by the students. The teachers also used WhatsApp social media to facilitate communication with students and parents. The obstacles to using technology in learning were the internet network which was not good enough and technological tools that were broken or even non-existent. The teachers' consideration of the proper use of media in learning shows that teachers had good pedagogical and content knowledge, even though they had not optimally utilized technology. The TPACK of the teachers, especially in geometry, is still at the recognizing level.*

**Keywords:** TPACK; geometry; elementary teachers

### **1. Introduction**

The subject of mathematics is systematically organized. Concepts in mathematics are interconnected. Mathematics learning needs to be conducted progressively from simple concepts to more complex ones (Wandini, 2019). Mathematics is found at every level of formal education, from elementary school to university. Geometry is a branch of mathematics that studies flat shapes and three-dimensional structures (Listiani, 2020). Sulistianingsih et al. (2017) presenting five reasons why it is important to study geometry, namely: 1) geometry helps humans develop a comprehensive perception of their world; 2) exploring geometry aids in the development of problem-solving skills; 3) geometry plays a key role in other fields of mathematics; 4) geometry is used by many people in everyday life; and 5) geometry is full of challenges and is intriguing."

Geometry is closely related to the formation of abstract concepts. This learning is not enough to be done using the lecture method alone, but students need to do certain activities to form an understanding of the concept (Nurhasanah et al., 2017). Students need to do activities such as



measuring, drawing, cutting, assembling nets to form a room, and so on. The teacher's role is to guide and facilitate students to carry out these activities. Thus, teachers have an important role in presenting learning materials, especially geometry, so that learning objectives can be achieved effectively and efficiently. The use of technology can increase the efficiency and effectiveness of learning (Handayani & Sulisworo, 2021) ) and make students more critical, creative, and independent in learning (Timotheou et al., 2023). Johar & Hanum (2021)

Presenting competencies that must be mastered by teachers, namely *Pedagogical Content Knowledge* (PCK) by combining knowledge about material and pedagogic content. Teachers need to have broad and in-depth knowledge related to the material to be taught. This is classified as *Content Knowledge*. In addition, teachers also need to understand the characteristics of their students and the right way to teach them. This has to do with pedagogy. The ability of teachers to teach certain material is adjusted to the characteristics of students, this is called PCK.

In the era of globalization, teachers need to be adaptive and master technology in education (Sofiarini & Rosalina, 2021). Teachers are required to master technological literacy and digital skills as an inseparable part of 21st century learning. The development of science and technology requires teachers to integrate technology in learning. Kunrade et.al. (2023) found that the use of technology, in this case learning videos and geogebra software, can encourage students to study harder and classical learning completeness is achieved, especially in Cube and Block learning. Isma and Fitriani (2022) suggest that by using technology, teaching materials can be visualized so that students become more interested in learning and learning becomes more interactive. Therefore, in addition to mastery of content and pedagogics, teachers need to have the competence to combine learning with technology. So, in carrying out the duties of teachers as educators and teachers, it is necessary to combine knowledge of material concepts, pedagogics, and the use of technology. This is covered in the idea Mishra dan Koehler (2006), namely *Technological Pedagogical Content Knowledge* (TPACK). Various studies related to TPACK have been conducted in Indonesia, but no such research has been found in elementary schools in Ma'rang District, Pangkep district. Preliminary observations show that elementary schools in Ma'rang sub-district already have technological devices such as laptops and projectors. It's just that the utilization of this device does not look optimal.

Along with the demands of using technology, schools already have technology, information, and communication facilities to support the learning process. The COVID-19 pandemic has accelerated teachers to have the ability to utilize technology in learning. During the pandemic, teachers learn fast and directly implement learning that utilizes digital technology or called *e-learning*. The Indonesian government supports the integration of technology in learning through various programs, including the Teaching Campus Program Anwar (2021) explaining the Teaching Campus Program as a form of student collaboration with schools, where students have the responsibility of assisting schools in terms of learning activities, technology adaptation, and administration. This indicates that schools that have been targeted by the Teaching Campus Program have integrated technology in learning.

Based on this, it is necessary to conduct research on the TPACK level of teachers in schools that have been targeted by the Teaching Campus Program. There are three schools in Ma'rang District, Pangkep Regency that have been schools where students of the Teaching Campus Program have been assigned, namely SD Negeri 6 Pitue, SD Negeri 13 Padang Lampe, and SD Negeri 20 Alesipitto. The purpose of this study was to determine the level of TPACK teachers in the school, especially in teaching geometry material.

## 2. Method

This research uses a qualitative approach with a type of descriptive research. The research data collected is qualitative and presented in the form of words to describe the research findings. The focus of research is TPACK teachers, especially on geometry material. The research was carried out in the even semester of the 2022/2023 academic year. The study was conducted in three schools in Ma'rang District, Pangkep Regency, South Sulawesi, namely SD Negeri 6 Pitue, SD Negeri 13 Padang Lampe, and SD Negeri 20 Alesipitto. The selection of these three schools was based on the consideration of having been the school where students were assigned to the Teaching Campus Program, one of whose activities was to help adapt technology in schools. The subjects of the study

were class V teachers in the three schools. Class V was chosen because the material students learned was already complex. Table 1 presents the demographics of the study subjects.

Table 1 Demographics of Research Subjects

Subject Code	Gender	Academic Qualifications	Teaching Experience	School Name
S1	L	S1 Counseling Guidance	23 years old	SD Negeri 6 Pitue
S2	P	S1 Elementary School Teacher Education	16 years old	SD State 13 Field Lampe
S3	P	S1 Elementary School Teacher Education	18 years old	SD State 20 Alesipitto

The instruments used in this study were interview guidelines and observation sheets. Interview guidelines are used as a guide in interviewing research subjects so that complete information can be obtained. Observation sheets are used to guide in observing learning carried out by teachers. Research data collection techniques through interviews, observations, and documentation. Research is focused on learning planning, learning implementation, and assessment of student learning outcomes, especially geometry material. Researchers conducted field observations and repeated interviews to ensure the consistency of the data obtained. The results of observations and interviews are categorized into teacher TPACK in planning, implementing learning, and assessing student learning outcomes.

Data analysis uses three stages, namely data condensation, data presentation, and conclusion drawing (Miles et al., 2014). Information obtained from research subjects is sorted and selected in accordance with the research objectives to be used as research data. Furthermore, the data is presented in the form of a description to be analyzed and conclusions drawn.

### 3. Results and Discussion

#### 3.1 Exposure to Research Dimensions

The presentation of dimensions in this study describes each *Technological Pedagogical Content Knowledge* (TPACK) grade V teachers of SDN 6 Pitue, SDN 13 Padang Lampe, and SDN 20 Alesipitto in planning, implementing learning, and assessing student learning outcomes on geometry material

##### 1. TPACK teachers in lesson planning

###### a. Use of technological devices in making RPP

Based on the results of observations, S1 is proficient in operating computer applications in the form of *Microsoft Office* which are commonly used in making RPP, such as *Microsoft Word*. Proven when in the teacher's room in making RPP or editing RPP using the *Microsoft Word application*. Based on interviews, it shows elements of *technology* where teachers prepare lesson plans before carrying out classroom learning using tools such as laptops and editing the lesson plans using *Microsoft Word applications*.

Based on the results of S2 observations using computer applications in the form of *Microsoft Office* which are commonly used in making RPP, this can be seen from the RPP that has been made and then printed for learning. The findings of this observation are reinforced by S2's statement at the time of the interview. Based on the results of the first interview and reinforced by statements in the second interview, S2 only uses the *microsof word* application for the purposes of making RPP. S2 uses the *Microsoft Word application* to edit the RPP that has existed in the previous year as long as the curriculum used is still the same, the results of the interview show elements of *technology*.

Berdasarkan hasil observasi S1 mahir dalam mengoperasikan aplikasi komputer berupa *microsoft office* yang biasa digunakan dalam membuat RPP, seperti *microsoft word*. Terbukti



ketika di ruang guru dalam membuat RPP ataupun mengedit RPP menggunakan aplikasi *microsoft word*. Berdasarkan wawancara menunjukkan unsur *technology* dimana guru menyiapkan RPP sebelum melaksanakan pembelajaran di kelas dengan menggunakan alat bantu seperti laptop dan mengedit RPP tersebut menggunakan aplikasi *microsoft word*.

Based on the observations, S3 is proficient in operating computer applications *in the form of Microsoft Office* which are commonly used in making RPP such as *Microsoft Word*, this is reviewed from when S3 observations show the preparation of RPP before learning is still in the form of files on the laptop. The findings of these observations are reinforced by S3's statement at the time of the interview. Based on interviews showing *technology* where teachers prepare lesson plans before carrying out classroom learning and using laptops, this is reinforced by the results of the second interview.

- b. The use of the internet as a source of information used for teaching materials.

Based on observations, S1 always uses the help of the internet as a source of information for teaching materials. S1 is looking for additional materials that will be taught to students through the help of the internet. The findings of this observation were reinforced by S1's statement during the first and second interviews. The interview results show elements *of technology* and *pedagogy*, because S1 uses the internet as a source of information used for teaching materials. The reason for using the internet as a source of information used for teaching materials is as a tool to find additional teaching materials, it shows the element of *pedagogy*. Based on the results of the first and second interviews, it shows elements *of technology* where S1 uses the internet as a source of information needed as teaching material. Furthermore, the element of *pedagogy* is found in the reason S1 uses the internet to find out how to do it if there is material that is poorly understood and the internet is also very helpful for students to find the material to be studied.

Based on observations, S2 always uses the help of the internet as a source of information for teaching materials. S2 is looking for additional materials that will be taught to students through the help of the internet. Based on the results of the first interview which is reinforced by statements in the second interview shows elements *of technology* and *pedagogy* because it uses the internet as a source of information used for teaching materials. The reason for using the internet as a source of information used for teaching materials is as a tool to find additional teaching materials, it shows the element of *pedagogy*.

Based on observations, S3 uses the help of the internet as a source of information for teaching materials. S3 is looking for additional materials that will be taught to students through the help of the internet. The findings of this observation are reinforced by S3's statements during the first and second interviews. The interview results show the element *of technology* because it uses the internet as a source of information used for teaching materials. The reason for using the internet as a source of information used for teaching materials is as a tool to find additional teaching materials so as not to be monotonous using books, it shows the element of *pedagogy*.

- c. Making your own technology-based learning media to be used as teaching materials

Based on the results of observations, S1 occasionally uses technology-based learning media. S1 uses more direct media for learning. The findings of this observation were reinforced by S1's statement at the time of the interview. Based on the results of the interview, it shows an element of *pedagogy* because teachers prepare learning media if the material is considered a bit difficult for children to understand. Based on the results of interviews, S1 sometimes uses technology-based learning media for the teaching and learning process. S1 only uses media if learning is considered rather difficult for students to understand. This shows that teachers are less than optimal in using facilities prepared by schools such as projectors.

Based on the results of observations, S2 rarely uses technology-based learning media, learning media that are often used are direct or real learning media shown to students. The findings of this observation are reinforced by S2's statement at the time of the interview. Based on the results of the interview, it can be seen that S2 always prepares learning media, but the



media used is real media instead of using technology. S2 rarely uses technology-based media for learning. When creating S2 media, you need the help of others to create the media. As some time ago there was training for media creation teachers using the Canva application, but the results of the training have not been applied to students. Based on the results of the interview, there is no element of technology, this shows that teachers are still not optimal in utilizing technology for learning media.

Based on the results of observations, S3 rarely uses technology-based learning media, the learning media that is often used is direct learning media shown to students. The findings of these observations are reinforced by S3's statement at the time of the interview. Based on the results of the interview, S3 always prepares media before carrying out learning, but the media used is real media instead of using technology. S3 rarely uses technology-based media for learning because it is caused by non-existent school facilities. The media used is often made by the teacher himself. Sometimes events are also held to show students' creativity in making space such as cubes, blocks, tubes and build other spaces, this includes elements of *content knowledge*.

## 2. TPACK of teachers in the implementation of learning

### a. Use of technological devices in teaching geometry materials

Based on the observations, S1 is proficient in operating computer applications in the form of *Microsoft Office* which are commonly used in learning purposes, namely *Microsoft Word* and *Microsoft Power Point*. The observation results show S1 when explaining using *Microsoft Office* to display to students. Based on the results of the first interview which was reinforced by the results of the second interview, it shows that there are elements of *technology* contained in the quote where teachers use technological devices in the form of *infocus* and *power point* applications in teaching geometry. This shows that teachers use technology by utilizing the internet as a source of teaching materials and *infocus* on presenting their material. Based on the interview results, S1 only uses *whatsapp* which is an application to communicate as a facility aid for learning, but teachers do not use applications such as *zoom*, *google meet*, or *google classroom*. The use of video in learning displayed through *infocus* on the whiteboard shows the element of *technology*. The reason teachers use videos downloaded from the internet and displayed through *infocus* is to make it easier for students to learn. Based on the results of the interview, S1 uses several technological devices in the form of applications such as *Microsoft Office*, *YouTube*, and *WhatsApp* for learning purposes. *Microsoft office* used such as *Microsoft Word* and *Microsoft Power Point* contains materials to be taught which are displayed through *infocus* (projector). As for the *YouTube* application, it was used to display learning videos displayed using a projector, but at that time teachers did not use videos in learning. Furthermore, to deliver materials or assignments to students, especially during the COVID-19 pandemic which is carried out online using only the *whatsapp* application. This shows that S1 is not optimal enough in utilizing existing applications such as *zoom*, *googlemet*, *googleclassroom* that can be used in learning.

Based on observations, S2 does not use technological devices. When the teaching and learning process takes place the subject only uses manual methods, in schools there are facilities to teach using technological devices such as laptops and projectors. Based on the results of the first interview reinforced by the second interview statement, S2 does not use technological devices for geometry learning. The use of technology is only in the form of a *youtube* application that is rarely used by S2 and the use of the application is not during learning, especially geometry. *Youtube* is only used occasionally for ice breaking in the form of singing to students. This is because the network in the area is inadequate to use technological devices.

Based on observations, S3 rarely uses technological devices in the learning process, teaching especially geometry material. S3 only uses teaching aids in the form of cubes and blocks to show to students. The findings of these observations are reinforced by S3's statement at the time of the interview. Based on the results of the interview, it shows that there is no element of *technology* in it because the facilities in the school do not yet exist. S3 only uses



manual methods in teaching geometry. However, there is an element of *content* where S3 immediately shows what examples of building space look like. Based on the results of the S3 interview, there are elements of technology but do not use technology in learning geometry material. This is because the facilities at the school are incomplete, the school does not yet have a projector that can be used to display material to students. YouTube video playback is only shown via *mobile phone* or laptop. S3 also rarely uses applications such as *zoom*, *google meet*, and *googleclassroom* for students because it is constrained by parents who cannot use these applications. Based on the results of the interview, it shows that the use of technology tools in teaching geometry at SD 20 Alesipitto is still very minimal. The learning carried out shows the content element *where S3 explains directly by showing geometric drawings*.

- b. Application of methods that can integrate mastery of material, technology, and pedagogics in learning

During observation, S1 uses the question and answer method where S1 shows directly objects around to explain what is building space, then giving examples of working on questions and then doing questions and answers to students. The findings of this observation were reinforced by S1's statement at the time of the interview. The results of the interview showed elements of *technology*, *pedagogy* and *content* where teachers use the internet to explain materials to students displayed on the screen and using methods that are considered quickly understood by students.

Based on the observations, S2 only uses the lecture and question and answer method, where S2 only explains the material and then conducts questions and answers to students. At the time of observation, S2 did not integrate technology in learning. The findings of this observation are reinforced by S2's statement at the time of the interview. Based on the excerpts of the first and second interviews, there is only an element of pedagogy in it. S2 has not applied learning methods that can integrate mastery of material and technology in learning, S2 only uses lecture and question and answer methods. S2 only explains learning materials directly such as using cardboard as props to be shown to students. Based on the presentation of the results of the study, it can be concluded simply that the understanding of TPACK grade V teachers of SD 13 Padang Lampe is at the level of acquaintance.

Based on the observations, S3 only uses the lecture and question and answer method, where S3 only explains the material and then conducts questions and answers to students. At the time of observation, S3 did not integrate technology in learning. The findings of these observations are reinforced by S3's statement at the time of the interview. Based on the results of the interview, there are elements *of pedagogy* and content where S3 uses the lecture and question and answer method, S3 explains the learning material directly, such as using props in the form of cubes and blocks to be shown to students. Then after being explained, S3 instructs students to come forward as far as explaining their understanding of building space. For example, by showing the sides or ribs, build a space, then do a problem such as finding the volume of a block.

- c. Use of social media to communicate with students regarding learning

Based on *observations*, it shows that S1 only uses social media in the form of whatsapp to communicate with students related to learning. The findings of this observation were reinforced by S1's statement during the first and second interviews. S1 uses whatsapp in communicating with students related to learning because whatsapp is an application that is easy to use and the average student already has it. Students use the application to ask questions about material that is difficult to understand and tasks that are not understood, it shows the element of *technology* in it

Based on observations, it shows that S2 only uses social media in the form of whatsapp to communicate with students related to lessons. The findings of this observation are reinforced by S2's statement at the time of the interview. Based on the results of the first interview and reinforced by the statement in the second interview, S2 only uses whatsapp in communicating



with students related to learning because whatsapp is an application that the average student can use. This shows that there is an element of *technology* in it.

Based on observations, it shows that S3 only uses social media in the form of whatsapp to communicate with students related to lessons. The findings of these observations are reinforced by S3's statement at the time of the interview. Based on the results of the interview there is an element of *technology*, S3 uses whatsapp in communicating with students related to learning because whatsapp is an application that the average student already has and is easy to use. The method used is to send photos of materials or assignments to whatsapp groups then instruct students to do it.

### 3. TPACK of teachers in learning assessment

#### a. Conducting tests/quizzes using technological devices

At the time of observation, S1 does not use technological devices in carrying out tests/quizzes. However, during the interview S1 provided information that sometimes S1 uses technological devices in carrying out tests / quizzes. Based on the results of the first interview which is reinforced by statements in the second interview, there is an element of *technology*. S1 sometimes conducts tests/quizzes using technological devices, but the observation takes place at the same time as S1 does not do this. The tests / quizzes carried out also only use *the Microsoft Word application*, this shows that S1 has not been optimal in the use of technological devices in carrying out tests / quizzes such as using the *quizzz application, googleform, and other applications*.

Based on the observations, S2 does not use technological devices in carrying out tests/quizzes. The observation results show that S2 only carries out tests/quizzes manually to students. This is reinforced by S2's statement during the first and second interviews. Based on the results of the first interview which was reinforced by the results of the second interview, S2 did not conduct tests / quizzes using technological devices, this shows that S2 has not been optimal in the use of technological devices in carrying out tests / quizzes such as using *quizzz applications, google forms, and other applications*. In this case, it shows that there is no element of *technology* in it.

Based on the results of observations, S3 does not conduct tests / quizzes using technological devices. S3 only conducts quizzes manually or directly to students, where students after being given material are appointed to come forward to work on questions. This is reinforced by S3's statements during the first and second interviews. Based on the results of the first interview which was reinforced by the results of the second interview there was no element of *technology*, S3 did not use technological devices in carrying out tests / quizzes for students. This shows that the use of technological devices in carrying out tests/quizzes is not applied in learning.

### 3.2 Discussion

The results in this study show that the level of understanding of *Technological Pedagogical Content Knowledge (TPACK)* of grade V teachers on geometry material content, especially in the use of technology for learning in accordance with student characteristics is classified as at the level of recognizing (Lyublinskaya & Kaplon-Schilis, 2022). This can be seen from the use of technological devices rarely used by teachers, such as the use of technology which is only used during a pandemic. Teachers have not made optimal use of technology in learning to develop learning materials, so they do not change the way learning materials are presented even though they use technological devices.

Teachers use *the Microsoft PowerPoint application* to teach geometry material. The results in this study are in line with the findings of research conducted by Liliase dan Tarigan (2017) which shows that teachers integrate the use of technology in learning using power point media. It's just that teachers have not been optimal in integrating technology in learning, because they only occasionally use these media. The use of technology in learning is only done if the teacher feels that students find it



difficult to understand the material. Teachers are also constrained from utilizing technology because the network factor in the area is inadequate. Teachers only use the method of lectures and questions and answers directly to students in teaching geometry material, and use direct media such as media made of cardboard that is shown to students. According to the teacher, by using media from cardboard, students understand faster. This is in line with research on Sundari dan Permanik (2022) the development of cognitive abilities through cardboard material media geometric shapes.

Another obstacle experienced by teachers in the use of technology in learning is the minimal school facilities. There are still schools that do not have tools such as projectors. Teachers play learning videos for students that are displayed directly on laptops or mobile phones, without the help of image magnifiers such as projectors. When learning online, teachers only use the whatsapp application. Learning carried out online seems monotonous, because teachers only use whatsapp as a medium to send assignments and the learning process is just sending photos of material in books with brief explanations via whatsapp group chat. The results in this study are in line with research conducted by Pribadi et al. (2021) which shows that teachers integrate the use of technology in learning using WhatsApp.

The results of this study show that teachers are still at the level of *recognizing*, because teachers have not optimally utilized technology in learning.

This is in line with findings that also found Idrus et al. (2022) that teachers only use technology to present material. Teachers draw geometric shapes using only Microsoft Word or Microsoft PowerPoint applications, not special applications for mathematics learning. Thus, teachers need to raise the TPACK level to the next stage, namely *accepting*, *adapting*, *exploring*.

Teachers need to receive training on the integration of the use of technology in learning to be much more optimal. TPACK is the type of knowledge that teachers need to teach well. Susana (2021) stated that TPACK is a basic component that needs to be mastered by teachers so that learning activities can run effectively and efficiently. Teachers need to master the three main components of TPACK, namely *Technological Knowledge* (TK), *Content Knowledge* (CK), dan *Pedagogical Knowledge* (PK) (Sintawati & Indriani, 2019).

#### 4. Conclusion

Based on the results of research and discussion, it was found that teachers have not made optimal use of technology in learning to develop learning materials, so they do not change the way learning materials are presented. Teachers use digital applications a lot during online learning due to the pandemic, but after the pandemic teachers returned to regular learning that does not use digital application technology. Teachers face the constraints of limited technological equipment and networks in schools. The level of *Technological Pedagogical Content Knowledge* (TPACK) of grade V teachers on geometry material content is still classified as *the recognizing* level. TPACK teachers need to be upgraded to the next stage, namely *accepting*, *adapting*, *exploring*, *advancing through training and completing supporting facilities in schools*.

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