



TECHNOLOGICAL PEDAGOGICAL AND CONTENT KNOWLEDGE (TPACK) SKILLS OF PRIMARY SCHOOL TEACHER EDUCATION STUDENTS

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Abstract

Technological Pedagogical Content Knowledge (TPACK) skills must be possessed by every prospective teacher, with TPACK skills possessed by prospective teachers being able to create learning by the characteristics of 21st-century human resources who have a high level of technological agility. This study aims to describe the TPACK skills of students as prospective elementary school teachers. The method used is descriptive quantitative, with data collection techniques through distributing questionnaires using a Likert scale. To determine the level of TPACK skills, level categories will be carried out, namely high, medium, and low. The subjects of this study were 61 elementary school teacher education students at the State University of Malang in their seventh semester. The results showed that the TPACK skills of prospective elementary school teachers were in the high category with a percentage of 70%. This means that students as prospective elementary school teachers already have aspects of TPACK skills.

Keywords: Technological Pedagogical Content Knowledge (TPACK); Pre Service Teachers; Teaching Readiness

1. Introduction

The Industrial Revolution 5.0 in the world of education in Indonesia brings technological innovations that allow the provision of broader and more flexible education, evidence that signifies the entry of the world of education into a new era, namely the development of science and technology that facilitates learning. The change from revolution 4.0 to 5.0 is a demand for education where teachers must be able to master technology by human resources that have 21st-century characteristics with a high level of technological agility, including the skills to interact with various digital platforms, master digital productivity tools, and understand how to use technology. The development of technology in the world of education is not limited to being used as a tool but has reached the stage where the school curriculum has begun to integrate technology in learning activities, where educators are required to be able to implement technology that aims to improve the quality of learning of students in the 21st century. In contrast to Industry 4.0 where technology is above humans, in era 5.0 humans are above technology. As part of higher education, pre-service teacher education functions to develop academic, professional, personal, and social abilities related to the role of teachers in learning in schools. Teacher education at the college level is equipped with knowledge and experience on how to become a teacher through learning in college as a step for self-development and an awareness of technology as a tool in learning.

For prospective primary school teachers to create a comfortable learning environment for students in the learning process, they must be able to integrate technology with learning practices, both related to learning content and pedagogical teacher candidates. The skills of teachers to integrate this technology is the basis for the development of technology and teacher

knowledge, namely PCK (Pedagogical Content Knowledge) by Shulman (1986), then became TPACK (Technological Pedagogical Content Knowledge) introduced by Mishra and Koehler (2006). This TPACK concept is in line with the competencies that must be possessed by Elementary School Teacher Education students as elementary school teachers where a teacher must be able to determine action instructions in teaching (Pedagogical Knowledge), understand deeply and thoroughly related to content knowledge, and be able to integrate appropriate utilization in implementing lesson plans (Technological Knowledge). By mastering the 3 components of TPACK to create new opportunities that can present content and pedagogy that did not exist before by Koehler, Hall, Bouck & Wolf (2011).

Professional teachers must be accompanied by high-flying hours (teaching), the teaching practice obtained by students is very limited and not yet fully in their teaching practice, because they are still accompanied and directed by local school teachers. The Teaching Campus (KM) or Teaching Assistance program makes a place for students to learn to integrate knowledge during lectures, this program can affect students' TPACK skills because they can find out the level of skills they have. Professional teachers must have adequate TPACK competencies because TPACK is within the realm of the four main competencies of a teacher which include pedagogical competence, personality competence, social competence, and professional competence obtained through professional education (Law Number 14 of 2005 Article 10). According to Keengwe et al. (2009), every teacher in all subjects must learn how to design and develop technology to achieve student success in learning in this modern era. These developments require prospective teachers to be able to integrate technology into learning, thus technology is a tool to package the learning process (McCormick & Scrimshaw, 2001). TPACK can help teachers in developing learning tools that can integrate elements of pedagogy, content, and technology (Chai, Koh, & Tsai, 2013). The integration must be structured for all subjects and of course pay attention to the specific classroom context (Koehler & Mishra, 2014).

This TPACK competency can be used as an analysis of the teacher's skills to teach to deal with changing learning patterns after Covid 19, where there is a shift in learning that focuses on the teacher, then shifts to students, which means that in a lesson students are more required to be active and the teacher directs, this shift is marked when participants take part in online learning during a pandemic, so that technology plays a role as a tool in learning. As prospective teachers, they must have the skills to use technology combined with content and teaching methods or TPACK skills. Relevant research conducted by Wardani, A. K., Suhartono, S., & Rini, T. A. (2022) related to TPACK analysis on the implementation of elementary school lesson plans with results showing that the weakest component is the integration of technology (TPK). Similar research was also conducted by Fuada, Z., Soepriyanto, Y., & Susilaningsih, S. (2020), related to the TCK Analysis of Elementary School Teacher Education Students with the results that the skills of students technically to develop multimedia is quite good, but there are still shortcomings in managing the content/material that will be included in the application, such as mastery of material and the skills to compile evaluations.

Teaching Skills

Teaching skills are abilities that must be possessed by every teacher to fulfill the teaching tasks carried out professionally (Kunandar, 2007: 57). According to Suwarna (2013: 208) "Teaching skills are the skills or proficiency of teachers in explaining concepts related to

learning". Another opinion states teaching skills are general teaching abilities as the main provision in the implementation of professional duties. (Alma, 2009: 22).

Elementary School Teacher

A person called teacher is a person who can design learning programs and organize and manage classes so that students can reach the level of maturity as the ultimate goal of the learning process, according to Hamzah B.Uno (2008: 15). According to Law No. 14 of 2005 in Rusman (2013), which describes teachers and lecturers, a teacher is a professional educator with the main task of educating teaching, guiding, directing, training, assessing, and evaluating students in early childhood education in formal education, basic education, and secondary education. According to Bafadal (2006: 6), professional teachers are teachers who have the right vision and various innovative actions. According to Santoso S. Hamijoyo (2002: 299-300), teacher competence is the right or authority that teachers have to teach, test, and assess the learning outcomes of their students. assess the learning outcomes of their students.

Technological Pedagogical Content Knowledge (TPACK)

Pedagogical Content Knowledge (PCK) was first introduced by Shulman in 1986, which was later added by Koehler and Mishra in 2006 to become Technological Pedagogical and Content Knowledge (TPACK). The TPACK framework was developed by Mishra and Koehler based on Lee Shulman's PCK (Pedagogic Content Knowledge) framework (Susana, 2021). Shulman suggested in Johar and Hanum, (2021) that PCK is a combination of knowledge about material content with pedagogical knowledge, further Speer and Wagner (2009) suggested PCK as a label used to describe what teachers know about material that causes student difficulties and how to overcome them. According to Rahayu (2017), TPACK is the knowledge needed to integrate technology into the learning process.

According to Chuang (2011), TPACK is a complex framework for the interaction between teachers' knowledge of content, pedagogy, and technology. According to Çoban, et al (2016), TPACK is a synthesis of knowledge that aims to incorporate information and communication technology and educational technology into the classroom learning process. TPACK is recognized in the field of educational research as a theoretical framework for understanding the knowledge needed by teachers to integrate three knowledge domains, namely technology, pedagogy, and content. Kohler & Mishra (2009: 62) explain that quality learning requires a complex and interconnected understanding of the three main sources of knowledge: technology, pedagogy, and content, and how they are applied in context. These relationships are described by Kohler & Mishra (2009: 63) in seven TPACK domains as follows:

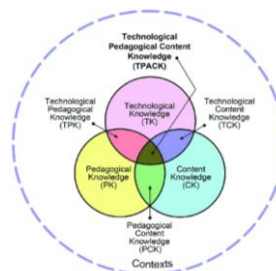


Figure 1. TPACK components

1) Content Knowledge (CK)

Content Knowledge or content understanding is the skills where the teacher masters the material or content of the subject to be studied and taught to students. Shulman et al (1986) noted that every teacher must master the subject matter which includes knowledge in the form of concepts, theories, ideas, frameworks, methods equipped with scientific methods, and their application in everyday life.

2) Pedagogical Knowledge (PK)

Pedagogical Knowledge is general knowledge of how students learn and how the learning process works, including knowledge of cognitive psychology, how student memory works, collaborative learning through groups, and so on. Teachers should have a deep understanding and focus on the required pedagogy of how students understand and build knowledge, attitudes, and skills (Koehler, et al. 2011). Examples: constructivism, scientific, discovery learning, problem-based learning, guided inquiry, question and answer, discussion, presentation, observation, and practicum.

3) Technological Knowledge (TK)

Technological Knowledge or technological understanding is knowledge about the use of technological tools, applications, and resources in the context of education. (Mishra et al) emphasize that basic knowledge, technological knowledge, and skills in used to support the understanding of the subject matter being studied.

4) Pedagogical Content Knowledge (PCK)

According to Shulman (1986:7), content knowledge and pedagogical knowledge must be combined in learning to create new knowledge, namely Pedagogical Content Knowledge (PCK). Gumilar (2016: 6) argues that PCK is knowledge that must be understood by a teacher because a teacher must know alternative concepts and difficulties that will be faced by students with diverse backgrounds and be able to organize, compile, run, and assess subject matter, all of which are summarized in PCK. PCK is a set of knowledge, subject curriculum and knowledge transformation, general pedagogy, and learning strategies in the context of education (Mishra, P., & Koehler, M. J. 2006).

5) Technological Content Knowledge (TCK)

Schmidt et al. (2009) defined Technological Content Knowledge (TCK) as knowledge of how technology can create new images in certain materials. The Technological Content Knowledge (TCK) domain is knowledge about how technology and content influence and limit each other (Kohler & Mishra, 2009).

6) Technological Pedagogy Knowledge (TPK)

According to (Charles R. Graham et al., 2009) Technological Pedagogical Knowledge (TPK) is the integration of technology with pedagogical strategies characterized by a large amount of "technology integration" literature, for example, how to manage a technology-integrated classroom that engages learners and create useful presentations. TPK requires an

understanding of the advantages and disadvantages of the required technology applied in the context of the subject matter that occurs in the learning process (Schmidt et al. 2009).

7) Technological Pedagogical Content Knowledge (TPACK)

TPACK summarizes a series in learning where the skills to master technology in an integrated manner that cannot be separated from each other from its constituent components Content, Pedagogy, and Technology. The TPACK framework can be used as a benchmark of knowledge and competencies that teachers can consider in managing learning. The TPACK framework can also be used as a reference in developing better teaching techniques, besides that the TPACK framework can also be used as a research guide related to prospective educators (teachers).

2. Method

The method used in this research is descriptive quantitative. According to Sudjanadan Ibrahim (in Jayusman & Shavab, 2020), descriptive research is research that seeks to describe a symptom, event, or phenomenon. For the quantitative approach, it is explained by Mulyadi (2019) that a quantitative approach is used when someone starts with a theory or hypothesis and tries to prove its truth. In this study, the descriptive method aims to describe the Technological Pedagogical Content Knowledge (TPACK) skills of prospective elementary school teacher education students at the State University of Malang.

The population in this study were Elementary School Teacher Education Students at the State University of Malang. The sampling technique used Non-Probabilities Sampling with the sampling technique used was purposive sampling. According to Dimiyati (2013, p. 61), Purposive Sampling is when the determination of subjects is not based on strata, regions, or random, but based on a specific purpose. This technique is carried out based on several considerations. The criteria for sampling in this study are students of the Elementary School Teacher Education Study Program who are taking semester 7.

The questionnaire instrument includes statements designed to measure the technological pedagogical content knowledge (TPACK) skills of Elementary School Teacher Education students. The questionnaire used in this study is an adaptation of the questionnaire developed by Denise A. Schmidt, Evrim Baran, Ann D. Thompson, Punya Mishra, Matthew J. Koehler & Tae S. Shin (2009) which amounted to 47 statement items. To obtain data, this study used a questionnaire in the form of a Likert scale:

Table 1. Likert Scale

| Scale Answer | Frequency |
|-------------------|-----------|
| Strongly Disagree | 1 |
| Disagree | 2 |
| Undecided | 3 |
| Agree | 4 |
| Strongly Agree | 5 |

To determine the descriptive statistical analysis that can be obtained with the help of the SPSS 25 program, the level of TPACK skills can be calculated manually using the level category formula presented as follows (Azwar, 1999, p. 105).

Table 2. Data Centering Measures

| Data Centering Measures | Formula |
|---------------------------------|--|
| Maximum Score (X_{Maks}) | Number of Items (n) X Maximum Score |
| Minimum Score (X_{Min}) | Number of Items (n) X Minimum Score |
| Mean Toretical (μ) | $\frac{Maximum\ Score + Minimum\ Score}{2}$ |
| Standard Deviation (σ) | $\frac{Maximum\ Score (X_{maks}) - MinimumScore (X_{min})}{6}$ |

The next step is to determine the category based on the scores obtained by Elementary School Teacher Education Students. Azwar (1999, p. 107) states that the purpose of this category is to divide individuals into separate groups in stages according to a continuum based on the characteristics measured. In this study, 3 level categories were used, namely (Azwar, 1999, p.109):

Table 3. Category Level Formula

| Interval | Category |
|--|----------|
| $X < (\mu - 1\sigma)$ | Low |
| $(\mu - 1\sigma) \leq X < (\mu + 1\sigma)$ | Medium |
| $(\mu + 1\sigma) \leq X$ | High |

3. Results and Discussion

3.1 Result

Data was obtained from research on students of the Elementary School Teacher Education Study Program, Class of 2020, State University of Malang with a total of 61 respondents consisting of Campus 1, Campus 2, and Campus 3. The most dominant sample is on campus 1 as much as 47.54%, and campus 2 as much as 32.79, and the least on campus 3 as much as 19.67%. Descriptive analysis was carried out to determine the results obtained from the study. Descriptive statistical analysis will be carried out twice, namely the analysis of TPACK in general and the analysis based on TPACK components.

Table 4. TPACK General Frequency Distribution

| Statistical | Data |
|-----------------------|--------|
| Number of Samples (N) | 61 |
| Mean | 182,44 |
| Standard Deviation | 20,601 |

The results of general descriptive analysis based on the table for Technological Pedagogical Content Knowledge (TPACK) data show an average or mean score of 182.44. Furthermore, level categorization is carried out with the calculation of level categories, obtaining results:

Table 5. TPACK General Category Classification

| Interval | Category | F | % |
|--------------------------|----------|----|-------|
| $X < 109,67$ | Low | 0 | 0 % |
| $109,67 \leq X < 172,33$ | Medium | 18 | 30 % |
| $172,33 \leq X$ | High | 43 | 70 % |
| Amount | | 61 | 100 % |

Based on Table 5, it can be seen that the Technological Pedagogical Content Knowledge (TPACK) skills is in the high category with a mean of 182.44 which is in the score interval $172.33 \leq X$.

Table 6: Frequency Distribution of TPACK Components

| Komponen | N | Mean | Standar Deviation |
|--|----|-------|-------------------|
| <i>Technological Knowledge (TK)</i> | 61 | 28,41 | 3,495 |
| <i>Content Knowledge (CK)</i> | 61 | 45,13 | 6,265 |
| <i>Pedagogical Knowledge (PK)</i> | 61 | 27,75 | 3,776 |
| <i>Pedagogical Content Knowledge (PCK)</i> | 61 | 14,93 | 2,435 |
| <i>Technological Content Knowledge (TCK)</i> | 61 | 15,66 | 2,359 |
| <i>Technological Pedagogical Knowledge (TPK)</i> | 61 | 20,26 | 2,588 |
| <i>Technological Pedagogical Content Knowledge (TPACK)</i> | 61 | 30,30 | 4,228 |

Table 6 shows descriptive data on the Technological Pedagogical Content Knowledge (TPACK) component. Furthermore, the classification of TPACK level categories will be carried out based on the components with the calculation of level categories, obtaining the following results:

Table 7. Category Classification of TPACK Components

| Komponen | Interval | Category | F | % |
|--|------------------------|----------|-----------|--------------|
| <i>Technological Knowledge (TK)</i> | $X < 16,34$ | Low | 0 | 0 % |
| | $16,34 \leq X < 25,66$ | Medium | 14 | 23 % |
| | $25,66 \leq X$ | High | 47 | 77 % |
| Amount | | | 61 | 100 % |
| <i>Content Knowledge (CK)</i> | $X < 28$ | Low | 0 | 0 % |
| | $28 \leq X < 44$ | Medium | 26 | 43 % |
| | $44 \leq X$ | High | 35 | 57 % |
| Amount | | | 61 | 100 % |
| <i>Pedagogical Knowledge (PK)</i> | $X < 16,34$ | Low | 0 | 0 % |
| | $16,34 \leq X < 25,66$ | Medium | 20 | 33 % |
| | $25,66 \leq X$ | High | 41 | 67 % |
| Amount | | | 61 | 100 % |
| <i>Pedagogical Content Knowledge (PCK)</i> | $X < 9,34$ | Low | 1 | 2 % |
| | $9,34 \leq X < 14,66$ | Medium | 24 | 39 % |
| | $14,66 \leq X$ | High | 36 | 59 % |
| Amount | | | 61 | 100 % |
| <i>Technological Content Knowledge (TCK)</i> | $X < 9,34$ | Low | 0 | 0 % |
| | $9,34 \leq X < 14,66$ | Medium | 18 | 30 % |
| | $14,66 \leq X$ | High | 43 | 70 % |
| Amount | | | 61 | 100 % |
| <i>Technological Pedagogical Knowledge (TPK)</i> | $X < 11,67$ | Low | 0 | 0 % |
| | $11,67 \leq X < 18,33$ | Medium | 13 | 21 % |
| | $18,33 \leq X$ | High | 48 | 79 % |
| Amount | | | 61 | 100 % |
| <i>Technological Pedagogical Content Knowledge (TPACK)</i> | $X < 18,67$ | Low | 0 | 0 % |
| | $18,67 \leq X < 29,33$ | Medium | 27 | 44 % |
| | $29,33 \leq X$ | High | 34 | 56 % |
| Amount | | | 61 | 100 % |

Based on the results of Table 7 regarding the classification of Technological Pedagogical Content Knowledge (TPACK) categories based on components in Elementary School Teacher Education Students, it can be seen that the seven components contained in Technological Pedagogical Content Knowledge (TPACK) have various categories of high, medium, and low. However, the most data is shown by the score interval $(\mu + 1\sigma) \leq X$. It can be concluded that all components of Technological Pedagogical Content Knowledge (TPACK) are in the high category.

3.2 Discussion

Technological Knowledge (TK)

Based on the data obtained from the survey results, the TK skills of Elementary School Teacher Education Students at the State University of Malang are in the high category with a percentage of 77%, where students have been able to learn the technology used in learning easily, this is related to the level of flexibility of students in following developments in technology and the ease of adaptation of students in integrating the learning process, making students aware of various types of technology in learning.

While the factors that affect the skills of kindergarten to be not maximized are in the process of using learning process technology, students have not been able to overcome technical problems if there are errors, or minor damage that occurs in the learning process. The technical skills possessed by students in the use of their respective technologies are lacking, this is due to the absence of opportunities obtained by students in using different technologies in learning. The use of the same technology is what causes students to lack knowledge of other technologies in learning so that technical problems encountered when using new or different technologies, still cannot be overcome optimally.

Content Knowledge (CK)

Based on the data obtained from the survey results, the CK skills of Elementary School Teacher Education students are in the high category, which shows that students have sufficient knowledge about mathematics, social science, science, and literacy taught in elementary school education. Shulman et al (1986) noted that every teacher must master the subject matter which includes knowledge in the form of concepts, theories, ideas, frameworks, methods equipped with scientific methods, and their application in everyday life.... A teacher with good content knowledge will be able to construct elements of learning materials at the same time, so as to be able to provide direction to students and not convey material at once.

Mastery of material in the scope of elementary school requires a deep way of thinking, this is because the learning contained includes more than one sub-knowledge but a combination of 2 or more sub-knowledge and is packaged in learning Theme 1, Theme 2, Theme 3, and so on. This theme of learning is a factor that makes elementary school teacher education students less optimal in thinking to convey knowledge material as a whole to students. The skills to think is very necessary to develop because if there are students who ask questions, prospective elementary teachers are ready to answer questions. Without good CK, the process of transforming subject matter to increase students' knowledge will not run well.

Pedagogical Knowledge (PK)

Based on the data obtained from the survey results, the PK skills of Elementary School Teacher Education Students at the State University of Malang are in the high category. This shows that prospective elementary school teacher students have pedagogical knowledge in the field of education such as developing lesson plans, classroom management, evaluating learning, models, methods, and learning strategies. PK abilities possessed by students even though they are in the medium category do not affect them because they already have knowledge and skills in teaching, but they must be developed again so that they can manage and organize classes in learning activities. similar to previous research findings of in-service teachers (Candra, Soepriyanto, and Praherdhiono 2020).

PK abilities possessed by students as prospective teachers in addition to classroom management skills, prospective teachers can understand the learning problems experienced by students in learning, so that prospective teachers can determine the teaching style used. This understanding of students is related to PK skills where prospective teachers are able to assess the performance of students with the most appropriate methods to be used in learning.

Pedagogical Content Knowledge (PCK)

The component leads to how students can choose an effective approach that is used in guiding students' thinking in understanding the material in the learning process. Gumilar (2016: 6) argues that PCK is knowledge that must be understood by a teacher because a teacher must know alternative concepts and difficulties that will be faced by diverse students, diverse backgrounds, and be able to organize, compile, run and assess subject matter, all of which are summarized in PCK. Given that students in teaching practice the longest time span when participating in the Teaching Campus or Teaching Assistance program, this still makes students not optimal in understanding how effective approaches are carried out in learning.

PCK skills are a combination of 2 basic components, namely PK and CK, although the 2 components obtained high category percentage results exceeding half of the sample, this will influence students' PCK abilities when applied in real learning, in the event in the field students are still not optimal in applying knowledge because the time owned by both the Teaching Campus program or Teaching Assistance is still limited. Teachers' PCK skills will increase when there is a good relationship between teachers and students, which will make teachers better understand the state of the class, and how students think, and interact with each other. So that teachers can find the right teaching methods to use.

Technological Content Knowledge (TCK)

The TCK component is a competency describing knowledge of the reciprocal relationship between technology and content (material). Teachers can create new ways and understand concepts in content with the help of certain technologies. The Technological Content Knowledge (TCK) domain is knowledge about how technology and content influence and limit each other (Kohler & Mishra, 2009).

Based on the data obtained and categorized, the majority of students can collaborate between technology (TK) and material (CK) in learning, such as students can create interactive multimedia used in learning, students can use animated videos as media that facilitate learning. This TCK skills means that students as prospective teachers can already understand which technology is suitable for delivering certain materials and how the content (material)

determines the use of the technology used, although there are still problems in overcoming technical matters in the use of technology experienced by students, but with the habit of students in using technology for learning purposes, these problems can be overcome.

Technological Pedagogical Knowledge (TPK)

TPK competence refers to students' critical thinking skills in selecting technology used in improving learning processes and outcomes combined with methods, learning models, and teaching methods in classroom learning, as well as students' skills in adjusting the use of technology mastered to support learning with different conditions. Students' teaching knowledge (PK) can be combined with using technology (TK) such as students using PPT in learning, using animated videos that aim to provide a clear picture of the material being taught, that is the skills of TPK where students use technology to support the process and improve learning outcomes.

Technological Pedagogical Knowledge (TPK) Is the integration of technology with pedagogical strategies characterized by a large amount of "technology integration" literature (for example how to manage a technology-integrated classroom that engages technology-oriented learning learners, and makes useful presentations (Charles R. Graham et al., 2009). As for the factors that can affect the TPK skills of students as prospective elementary school teachers, namely the lack of teaching experience in the classroom, causing students still not have sufficient opportunities to integrate technology, although there is still a lack of direct experience in teaching, but from the data obtained students have high knowledge about the use of technology in the learning process through methods and approaches to improve learning outcomes.

Technological Pedagogical Content Knowledge (TPACK)

TPACK competence leads to students' skills to guide students by using an understanding of the use of technology, content, and learning approaches. With the results obtained, it can be said that the readiness of students in teaching has been able to go directly to real classroom learning. Based on the data obtained, the percentage of 44% of students' TPACK skills is in the medium category and 56% in the high category, this result is influenced by the low CK (Content Knowledge) and PCK (Pedagogical Content Knowledge) where students have not maximized their mastery of the content applied in classroom learning, another factor is that students' experience in implementing classroom learning is still not optimal. Regarding the results of the 6 components obtained by previous students, considering that the relationship between technology, content, and pedagogy cannot be separated. Which means that if the results of one component are still not optimal, it will affect students' TPACK skills in teaching readiness. Factors that influence students' TPACK skills besides the results of the 6 components, are also influenced by habits in using technology in everyday life and students' habits of using technology during lectures, these habits can increase students' skills to integrate technology in the learning process.

TPACK skills can foster active learning that focuses on students, it can be interpreted that TPACK skills is a provision for prospective teachers in facing a shift in learning that was originally teacher-centered shifting to students, where teachers can integrate technology in learning. Learner-centered means that in learning, students are required to be active and more independent in exploring material through learning media that is integrated with technology,

and the teacher as a companion and directs students' understanding by learning objectives. According to Keengwe et al. (2009), every teacher in all subjects must learn how to design and develop technology to achieve student success in learning in this modern era. The shift of teacher-centered learning to learners is influenced by technological developments so that in the learning process prospective teachers can use learning media such as learning videos, interactive multimedia, e-modules, augmented reality, and virtual reality. Through technology-based learning media, students can learn independently and teachers assist students in learning using technology as needed. Through lectures conducted by Elementary School Teacher Education students are expected to be able to collaborate technology, pedagogy, and also content simultaneously in learning.

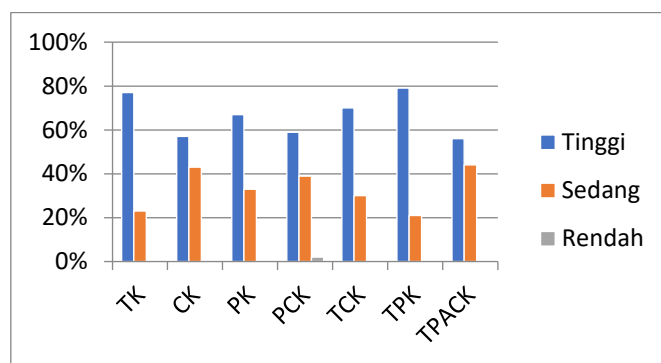


Figure 2. Diagram of Students' TPACK Skills Level

4. Conclusion

Based on the results of data analysis and descriptive discussion that has been described, it can be concluded that students' TPACK skills are in the high category, but need to be improved again for CK and PCK abilities. For CK 57% high and 43% moderate, students have not maximally mastered learning materials in the form of theme 1, theme 2, and so on. While PCK is 59% high, 39% medium, and 2% low where students have not been able to convey material well in learning, although they understand teaching methods in class, but student experience in teaching in class is still limited. The lack of CK and PCK abilities of students results in TPACK skills of 56% high and 44% moderate, where students have not maximized in combining technology, content, and also teaching methods in learning.

Based on the conclusions of the research results, there are several suggestions for students to further improve their TPACK skills to master and apply competencies in learning. Students are expected to maintain their competence because the integration of technology in the learning process at this time and in the future is needed along with the development of increasingly modern times. For the Department of Elementary School Teacher Education, it is hoped that it can improve the performance of teaching methods of lecturers who collaborate with learning strategies and methods combined with technology, and the department is expected to be able to provide courses tailored to the learning needs of era 5.0 which makes technology a learning tool.

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