



# Technology, Pedagogy, and Content Knowledge (TPACK): A Perspective from Indonesian Undergraduate Students

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**Abstract.** Teachers' technical skills are critical to the learning process that facilitates student understanding. Using technology-based learning is one of the initiatives undertaken to improve their comprehension. Utilizing technology is one of the learning media that can be used in various fields of education at all levels. But not all educators can understand and apply technology-based learning. This relates to TPACK-based learning. The application of the TPACK framework in the learning process allows teachers to develop their knowledge so that it will make a good contribution to student learning outcomes. The purpose of this study was to determine how undergraduates perceived taught technology, pedagogy, and content knowledge (TPACK), and how they utilized TPACK for learning. This investigation uses a survey methodology. The population comprised 190 undergraduate students, but the sample returned only 60 responses. The TPACK competence scale was used for data collection. Overall aspect scores of 87.59 revealed that the student's perceptions of their professors' TPACK competency fell into the very good level. This indicates that pupils believed their instructors were capable of implementing the technology. Students acquired TPACK by witnessing the lecturer's instruction and conducting internet-based self-study. This study implies that lecturers could increase the quality of their language instruction by incorporating technology.

**Keywords:** TPACK, Perceptions, Lecturer Competency, Instructional Quality.

## 1 Introduction

Learning requires technology, communication, and knowledge in the Era of Society 5.0. The emphasis of learning requirements is on increasing students' originality, productivity, flexibility, and competitiveness. Considering the Era Society 5.0 learning criteria, teachers can utilize technological innovations to help students become more adept at comprehending lesson content [1].

The teaching and learning process evolves alongside the progress and growth of civilization. Nowadays, education must be adapted to the prevailing rate of growth [2].

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J. Handhika et al. (eds.), *Proceedings of the 4th International Conference on Education and Technology (ICETECH 2023)*, Atlantis Highlights in Social Sciences, Education and Humanities 25,  
[https://doi.org/10.2991/978-94-6463-554-6\\_6](https://doi.org/10.2991/978-94-6463-554-6_6)

Methods, tactics, and the utilization of learning materials are all crucial. During this period of expansion, it is desired that educators maintain their professional competencies. When performing professional competence development, instructors should be inventive in several ways, particularly in terms of their competence, so that it has a good impact on teaching [3], [4].

In addition, the constant evolution of technology and information has a substantial impact on education [5]–[8]. To respond to the problems of the revolutionary 5.0 sector, it is necessary to integrate technology into the learning process in the modern era. Teachers must use technology to enhance the quality of instruction [9]. In this situation, students become familiar with technological developments. They view it as more than just a teaching instrument, but also as a learning aid.

### 1.1 Conceptual or Theoretical Framework

For educators, it is difficult to integrate technology into education in a meaningful way. To choose the proper technology for instruction, a teacher must have a comprehensive understanding of the content or subject matter. Educators must also select instructional practices that are compatible with the used technology, which demands pedagogical knowledge. Consequently, to properly integrate technology, a teacher needs to acquire knowledge of learning material content, pedagogy, and technology [10]. These three facets of knowledge combine to provide Technological Pedagogical Content Knowledge [11].

Observing teachers' Technology, Pedagogy, and Content Knowledge (TPACK) provides insight into their ability to integrate technology into the classroom [12]. The TPACK Educator Knowledge Framework is defined as the complex interplay of three forms of knowledge (i.e., technology, pedagogy, and content) and their interrelationships [13]. It is uncertain whether teachers' content knowledge is proportional to their pedagogical and technological skills [14]. A teacher may be intellectually capable yet lack instructional and technical expertise. Furthermore, it is questionable whether teachers with subject knowledge and high levels of teaching experience are also technologically competent. Therefore, it means that applying the right technology in learning can determine the success rate of student learning.

In integrating technology-based learning several elements must be understood by educators. Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) are the three essential components of TPACK. Then, the four components of TPACK that are combined are Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPCK) (Rosenberg & Koehler, 2015; Valtonen, Sointu, Mäkitalo-Siegel, & Kukkonen, 2015).

Strengths of TPACK: 1) Holistic Integration: TPACK promotes a more holistic integration of technology, pedagogy, and content knowledge in teaching. This helps teachers plan and deliver more effective instruction; 2) Enhanced Learning Experiences: By using TPACK, teachers can create more engaging and interactive learning experiences for students. Effective technology integration can make learning more interesting; 3) Contextualized Learning: TPACK helps teachers contextualize learning

by connecting technological, pedagogical, and content knowledge to real-life teaching situations; 4) Teacher Skill Development: TPACK stimulates teacher skill development because teachers need to understand how to use technology in their teaching contexts; 5) Adaptation to Change: TPACK helps teachers adapt to changes in technology and education. They can continually update their knowledge in all three domains.

Weaknesses of TPACK: 1) Complexity: TPACK is a complex framework that requires a deep understanding of technology, pedagogy, and content. This can be a challenge for teachers who are not accustomed to integrating technology into their teaching; 2) Required Training: Teachers need appropriate training to understand and implement TPACK effectively. This training takes time and resources; 3) Knowledge Gaps Among Teachers: Not all teachers have the same level of technology knowledge and skills. This can create gaps between tech-savvy teachers and those with lower tech skills; 4) Time Demands: Integrating TPACK may require more time in lesson planning. Teachers need to plan carefully to incorporate technology with the subject matter; 5) Not Always Suitable for Every Context: TPACK may not always be the right approach in every teaching situation. Sometimes, traditional teaching methods may be more appropriate.

TPACK is crucial for the school system, particularly for teachers, as they are the ones responsible for educating the next generation. Numerous research demonstrates that TPACK implementation in the classroom still requires careful consideration for successful learning. The TPACK framework is essential for examining educators' perceptions of their self-efficacy and considering professional development possibilities related to the appropriate integration of technology into the classroom. However, actual teaching practice has received only a minor amount of attention [16]. The researcher is interested in determining whether educators have been successful in implementing TPACK-based learning and what the students' perspectives are on this because of this.

## 1.2 Related Research

Previous research on TPACK education has yielded conflicting results. Intan et al. (2019) found that teachers' TPACK competencies affect students' learning environments, especially when teachers have pedagogical knowledge and are supported by technology. Furthermore, it has been proven that preschool teachers have sufficient self-efficacy to integrate ICT (Information and Communication Technology) into all TPACK categories [17]. TPACK has extensive experience in education, technology teachers modeling, and the use of technology in fieldwork [18]. The TPACK competencies of students may vary by gender, educational level, and field of study [19]. They demonstrated that Ph.D. students had a more positive evaluation of their knowledge and skills on the TPACK scale dimensions. This study intends to analyze the lecturers' TPACK competence and how students gain TPACK in learning from the student's perspective to close the gap.

## 1.3 The Purpose of The Study

This study tries to establish whether or not instructors can implement TPACK. In addition, this study explores how students view teachers' technological application skills in

the classroom. The outcomes of this study are anticipated to give educators, researchers, and students with useful information regarding the significance of enhancing lecturer proficiency with technology. It is envisaged that lecturers with strong TPACK skills will establish TPACK professional development opportunities, resulting in more effective technology integration.

## 2 Method

### 2.1 Participants

This study was conducted with a combination of qualitative and quantitative methods. The study involved 190 students enrolled in the Indonesian language teaching program at Asahan University in the 2021/2022 academic year. A sample of 60 students was then drawn using a targeted sampling method.

### 2.2 Data collection

This research utilized a questionnaire and a guided interview as its instruments. The survey was adapted from Tseng [20]. The questionnaire was validated by three experts and tested to determine its reliability. The students' cognition of the lecturer's TPACK ability was collected through a questionnaire survey, including seven aspects of TK, PK, CK, TPK, TCK, PCK, and TPACK detailed in table 1 below:

**Table 1.** Aspects Abbreviation

<b>Abbreviation</b>	<b>Aspects</b>
<b>TK</b>	Technological Knowledge
<b>PK</b>	Pedagogical Knowledge
<b>CK</b>	Content Knowledge
<b>TPK</b>	Technological Pedagogical Knowledge
<b>TCK</b>	Technological Content Knowledge
<b>PCK</b>	Pedagogical Content Knowledge
<b>TPCK</b>	Technological Pedagogical Content Knowledge

The survey was distributed using Google Forms. Before presenting the questionnaire to the pupils, an expert evaluated its content and language usage for accuracy. The questionnaire was formatted using closed-ended questions. The multiple-choice questions permitted students to select the most appropriate response from various possibilities [21]. As suggested by Sugiyono, students are instructed to indicate their level of agreement using the Likert scale: strongly agree (5), agree (4), neutral (3), disagree (2), and severely disagree (1).

### 2.3 Data Collection Process

The participants who filled out the questionnaire were sixty fifth-semester students. For the interview phase, 25 students were selected using a random sample procedure. The researcher then conducted interviews with them to support the initial results. The interview was conducted following the distribution of the questionnaire. The interview determined how students gained TPACK during their educational experience. The interview data were recorded, transcribed, and evaluated to reply to the queries on how students acquired TPACK during the learning process.

### 2.4 Data Analysis

The questionnaire scores are sorted by aspect and then added up. The final score for each aspect is determined by the following formula:

$$Final\ score = \frac{Total\ score}{Maximum\ score} \times 100$$

The highest score is the total score (score = 5) for each respondent when they selected the option "Strongly Agree". Since each aspect contributes 5 points, the maximum score value for each aspect is 1500. (Note: 60 total respondents). The scores obtained are then classified according to the following criteria: (1) 85 and above as very good; (2) between 70 and 85 as good; (3) between 55 and 70 as average; (4) A score between 40 and 55 is considered reasonable; (5) A score below 40 is considered poor.

## 3 Result

As noted previously, the Likert scale utilized in this study investigated seven TPACK aspects. The average scores are shown in Table 2. The sections that follow detail the analysis results for each aspect.

**Table 2.** Mean Score of Seven Aspects

Aspects	Score	Category
TK	90.52	Very Good
PK	88.12	Very Good
CK	81.12	Good
TPK	90.35	Very Good
TCK	87.57	Very Good
PCK	84.37	Good
TPCK	91.11	Very Good
Total	87.59	Very Good

### 3.1 Technological Knowledge (TK)

Technological Knowledge refers to the lecturer's familiarity with new or digital technologies, such as the internet, smartphones, computers, laptops, and software packages. Students respond to five questions. The results indicate the TK aspect score was 90.52, which can be considered very good.

During online classes, lecturers become well-versed in the necessary computer components. Troubleshooting technical difficulties with the devices, such as setting up WiFi, using a webcam, and printing is also something they learn. Additionally, professors make use of Zoom Meetings for their classes and motivate students to create papers that can be shared on various online platforms like Facebook. The knowledge of the lecturers turns into the most valuable resource because it is essential for acting effectively in a variety of uncertain situations. Knowledge usually consists of appropriate information, context, experience, judgment, and insight. By ensuring the survival and expansion of ICT, lecturers add value because comprehension and meaning are necessary for effective action [22]. Lecturers with technological abilities and skills will have easier access to information and learning resources, as well as the ability to share knowledge and content with other lecturers. And university policy can be agreed upon by the university, lecturers, and students to find out what learning is taking place. As a result, teaching can be done fairly [23]. It can be demonstrated that lecturers were prepared to transition to the modern learning environment.

### 3.2 Pedagogical Knowledge (PK)

Pedagogical Knowledge represents the lecturers' knowledge of course organization, classroom management, and evaluating student learning. Five questions were presented for student responses. The PK aspect has a score of 88.12, which is regarded as a good category.

According to the students' perceptions, lecturers employ several instructional and evaluative procedures in the classroom. This facilitates student comfort throughout the teaching and learning process. The instructors actively provided students with performance criticism, knew how to manage the class, and built positive relationships with students. The data shows that the instructor's presence affects student satisfaction. When lecturers can structure courses and organize classes properly, this has a significant influence on student satisfaction [24]. It is also confirmed that lecturer competencies such as subject knowledge, presentation clarity, interaction with students, teaching creativity, clarifying learning outcomes, class activity, and lecture notes are all positively related to student satisfaction [25]. The quality of the instructor, course design, prompt feedback, and student expectations all have a positive impact on student satisfaction and positively influence student performance [26], [27]. In summary, Pedagogical Knowledge is needed to support the progress of not only student learning outcomes but also student satisfaction.

### **3.3 Content Knowledge (CK)**

Content Knowledge is the teachers' comprehension of the class material. Five items had been completed by the students. The outcome demonstrates that the CK aspect has a score of 81.12 (good). The majority of students' responses to the teachers' CK questionnaire indicated that the lecturers had an in-depth understanding of the course material and communicated it using simple language and useful examples. Their ability to teach the subject is also impacted if they lack these skills. Instructions may not be continuously given to students, and frequently, intelligent and inquisitive students' questions may not be adequately answered [28]. Students will, however, more readily accept and comprehend more challenging subjects when the instructor is an expert in the subject matter. It can be proven that a teacher's content knowledge had a positive relationship with the student's learning achievement [29]. The general self-efficacy of teachers, which predicted students' conceptual understanding of the material being taught as well as their interest in the subject, was the most important component of teacher competence [30].

### **3.4 Technological Pedagogical Knowledge (TPK)**

Technological Pedagogical Knowledge is educators' awareness of how to adapt specific educational techniques to affordance technologies. This aspect's score in this aspect is 90.35 (Excellence). Following the results of the questionnaire, the majority of lecturers are regarded to stimulate students to study, explain the content clearly, connect with them more, support instructional activities, and be able to choose which technology to convey information by employing. Teachers emphasize the importance of digital literacy to acquire new skills, abilities, and competencies and to promote mental changes that allow them to improve their teaching practice [31]. In order to create effective teaching strategies in the classroom, teachers must be aware of the needs and requirements of their students' learning [32].

### **3.5 Technological Content Knowledge (TCK)**

TCK is educators' understanding of how content is transmitted via multiple mediums. The result reveals that this aspect's score is 87.57 (excellence). The majority of student responses to the TCK survey suggested that the lecturer employs digital teaching materials to assist students in reading, speaking, and learning the topic. Learning is required to adapt to technological developments to make learning more effective and dynamic [33]. Teachers must be adept at integrating technology, pedagogy, and materials [34]. The teacher always considers effective learning by utilizing resources such as computers, projectors, and the internet, which are integrated using various learning models that are material-adapted.

### 3.6 Pedagogical Content Knowledge (PCK)

This field focuses on how teachers implement instructional strategies to communicate material, alleviate learner challenges, and improve student understanding. The results showed that the PCK aspect scored 84.37 (Good). The majority of student responses to the PCK aspect questionnaire indicated that activities planned by teachers helped students practice and enjoy learning more. The development of instructional content knowledge is critical for educators. Teachers must understand the subject area and pedagogy for which they are responsible. Otherwise, students may experience learning difficulties. Improving teachers' PCK may result in better instructional practices and, as a result, higher academic achievement for students [35]. Teachers with a high level of PCK are better teachers.

### 3.7 Technological Pedagogical Content Knowledge (TPCK)

TPCK emphasizes the dynamic, interactive relationships between the three components of knowledge. The result reveals that the TPCK aspect score was 91.11 or a Very Good level. The majority of students' responses to the survey on the TPCK aspect suggested that the lecturer may provide information with the appropriate technique through various technologies and use computers to convey the content of the syllabus to make students learn easier and more effectively. Each teacher can create their curriculum and supplementary materials using modern technology, using their creativity to individualize learning [36]. Although many people prefer traditional teaching techniques, incorporating technology into the classroom unlocks many positives and introduces students to paperless learning. With a wide range of available degree options and learning methods, education has become much more widely available. Teachers ought to consider why students desire rather than require technology in the classroom. It will undoubtedly help teachers monitor students' progress and create creative lesson plans. Technology-based education allows students to develop skills that will help them succeed in the future [37]–[40].

## 4 Discussion

The students' perception of TPACK was positive, indicating that they believe teachers can effectively incorporate technology into their teaching of the Indonesian language. The proficiency scores for TPACK vary slightly among instructors. When using the Likert scale, the aspect of TPK received the highest mean score (90.35). Following closely behind were TK (90.52), TPCK (91.11), PK (88.12), TCK (87.57), PCK (84.37), and CK (81.12). Each aspect was rated very goodly, with CK and PCK falling into the good category. Furthermore, the mean score across all aspects was 87.59, a good rating according to the scale.

TPK refers to understanding how different technologies are implemented in the classroom and how technology can revolutionize teaching styles [41]. Teachers need to apply their pedagogical understanding of technology in the classroom to implement



various instructional techniques such as differentiating instruction and guiding students to organize learning [42]. Based on the results, teachers can implement various technologies to support the learning process in the classroom and ensure that students learn and assimilate lessons effectively and quickly.

The students' motivation and intrigue about the course topic grew when lecturers provided technology to gather information. This preference for technological learning may be attributed to the majority of students being in their second or third year of education, where they have gone through the application of teaching concepts and completed university requirements such as micro-teaching, material development, lesson design, and language teaching methodology. Therefore, TPK was found to be greater than TCK in this context. According to student interviews, students often use technology, against their teacher's instructions, to access learning materials for their subject. This includes activities such as researching in the form of scientific papers and searching for references online. Students agree that they have easy access to using technology for educational purposes, as they can access teaching resources both at school and at home.

Moreover, CK has the lowest value among all aspects. Although this field has the lowest percentage, it shows that students are positive about the good categories. The grade for CK was the lowest due to the student's perception that the lecturer required them to study individually to explore the content, gave few examples, and repetitively presented the material. In other words, despite the lecturer's perceived inadequacies, the lecturer's understanding of the subject matter can still be categorized as very good. Instructors' subject matter competence provides appropriate learning methods and procedures, indicating that they are knowledgeable [43]. Conclusively, this aspect still needs to be reviewed to improve teacher competence in delivering material.

The findings of this study contrast those of [44] who determined that CK had the highest score in their study. This is due to the various educational levels of the research participants. They included adolescents in their research. Meanwhile, undergraduate students are participating in this investigation. This is clear given that differences in educational levels affect content comprehension. Undergraduates have more leeway to study related material. In contrast, high school students rely on their teachers to impart the material.

PCK has the second-lowest score among all TPACK aspects, according to the statistics. The professors' PCK remains in the very good category despite being the second aspect to have a lower score than the other aspects (84.37). It indicates that both the lecturers' knowledge of the subject matter and their teaching methods are deemed adequate by the students. The interview verified these findings.

The students believed that teachers provided them with quizizz.com-like online quizzes and encouraged them to participate in group activities. Students said it improved their academic performance and provided them with new learning opportunities. This remark is consistent with Goksun & Gürsoy (2019) that implementing Quizizz had a positive impact on student achievement and engagement. For teachers, quizzes can be an innovative and promising tool to engage students in creative learning and exciting competitions [46].

The findings suggest that professors are applying technology at the course material level by incorporating software features for language learning. The instructor provides examples of using QuillBot, for example, to paraphrase sentences, choosing relevant terms. In addition, instructors provide opportunities for students to use other software features taught in class. This motivates students to independently research learning resources, thereby enabling them to acquire knowledge. Furthermore, reporting data loss related to two aspects of the research question: teacher supervision and participation in self-directed learning.

#### 4.1 Observing the Lecturers

In response to several questions, many students reported that they learned TPACK by observing their instructors' classroom practices. The following student statements demonstrate this point.

"Since the first semester, my professors have consistently utilized technology in the classroom. They frequently employed technology such as PowerPoint, Prezi, and tools like Quizziz to make classes more engaging." (Student 8)

"From year sophomore to year three, our lecturers use a variety of learning tools such as the Mendeley app, Publish or Perish, and Quillbot which was introduced as a very useful program when creating academic writing." (Student 11)

"Yes, my academic performance improved after utilizing some of the tools offered by the instructors. I am more motivated to complete my assignment as a result." (Student 14)

Most students say their professors integrate and encourage the use of a variety of technologies and applications, including Mendeley, Publish or Perish, and QuillBot. Therefore, technology is essential to the learning process to improve the quality of education. This was confirmed by Çoklar & Yurdakul [47], who found that improving the quality of education was the most common reason educators use technology in schools. Similarly, Fan & Song (2020) found that using technology in the classroom can improve instructional performance and student engagement.

#### 4.2 Completing Self-Learning

Furthermore, the second point relates to the student's daily self-learning, as demonstrated by the following interview results.

"I discovered more applications that facilitate the writing of scholarly papers. For instance, the YouTube application associated articles assisted me in writing my study background." (Student 7)

"The technology used by the instructors is very advantageous. I became more interested in doing technology-based scientific work assignments introduced by the instructor.." (Student 6)

Moreover, the results revealed that students acquired TPACK through independent study. They become more curious and enthusiastic about writing projects when they discover additional programs that assist them finish their work more efficiently. Tech-

nology grants students greater autonomy and control over their education [49] encourages higher classroom participation, and facilitates collaborative learning [50]. It can be deduced that technology could aid pupils in exploring a variety of topics and increase their interest in studying.

## 5 Conclusion

It scored an average score of 87.59 across all domains, with Knowledge Teaching Technology (TPK) scoring the highest. In this study, researchers managed to identify the views and understandings of undergraduate students about the TPACK framework. The results showed that students have a varied understanding of TPACK and have a positive perception of integrating technology in learning. The findings provide valuable insight into students' level of preparation for future technological challenges in education. Although this research provides valuable insights, there are some challenges faced in implementation. One of the main challenges is the availability of facilities and limited access to technology. In addition, the lack of training for lecturers in integrating technology effectively is also an obstacle. This study has several limitations that need to be noted. First, the study sample was limited to fifth-semester undergraduate students at Asahan University, so the findings may not be able to be announced to the entire population. In addition, this study focuses on students' perceptions and understandings, and does not measure the practical implementation of TPACK in a real context.

To improve understanding of TPACK and its implementation, future research could focus on educators at various levels of education. In addition, more in-depth research can be conducted to explore best practices in integrating technology in learning in Indonesian educational environments. Furthermore, understanding the impact of TPACK implementation on student achievement and learning outcomes can be an important research topic in supporting the development of more effective curriculum and learning strategies. This research can serve as a basis to inform future education policy and improve the quality of education in Indonesia.

## 6 Recommendations

This study is limited by the small population and sample sizes. To cover a broader population and examine other variables, future research is planned to compare private and public universities' perceptions of their faculty's TPACK skills. Future research could expand this to a population scale, comparing private and public universities' technology literacy, and the willingness of teachers and students to use technology in the learning process. In addition, learning factors can be linked with learning models and learning media to achieve better results. Future scholars are expected to have access to more inclusive tools and become representatives of 21st-century learning.

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