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TPACK Learning Model

Rodiatul Mutmainah[1]

[1]Program Studi Magister Pendidikan Bahasa Inggris
Universitas Islam Negeri Sultan Maulana Hasanudin, Banten
* Corresponding Author e-mail: 232623211.rodiatul@uinbanten.ac.id

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Abstract: *Effective integration into instruction and learning is crucial in the fast-changing environment of today's education. The Technological Pedagogical Content Knowledge (TPACK) model offers a complete framework for understanding how teachers can use technology, pedagogy, and content knowledge can enhance students learning. This study investigates the theoretical foundations of TPACK, its role in addressing issues in technology-based instruction, and its practical applicability in educational context. This study emphasises the importance of TPACK in promoting effective, technology-integrated teaching methods by investigating the intersection of pedagogy, content, and technology.*

Kata Kunci:

The Technological Pedagogical Content Knowledge (TPACK), Information and Communication Technology (ICT), pedagogical knowledge (PK), technological knowledge (TK), and content knowledge (CK)

Abstrack: Integrasi yang efektif ke dalam pengajaran dan pembelajaran sangat penting dalam lingkungan pendidikan saat ini yang berubah dengan cepat. Model Technological Pedagogical Content Knowledge (TPACK) menawarkan kerangka kerja lengkap untuk memahami bagaimana guru dapat menggunakan teknologi, pedagogi, dan pengetahuan konten dapat meningkatkan pembelajaran siswa. Studi ini menyelidiki landasan teoritis TPACK, perannya dalam mengatasi masalah dalam pengajaran berbasis teknologi, dan penerapan praktisnya dalam konteks pendidikan. Studi ini menekankan pentingnya TPACK dalam mempromosikan metode pengajaran yang efektif dan terintegrasi dengan teknologi dengan menyelidiki persimpangan pedagogi, konten, dan teknologi.

Introduction

In present ever-changing educational landscape, effectively integrating technology into teaching and learning processes is critical. Teachers need to learn how to navigate and use digital tools efficiently as technology becomes a more and more important part of education. TPACK pushes educators to keep abreast of technology developments, which enhances instruction and serves as an example of digital competency for students.

The Technological Pedagogical Content Knowledge (TPACK) model offers a comprehensive framework for understanding how teachers can use technology, pedagogy, and content knowledge to improve student learning. In the development of TPACK model, Misha and Koehler extended on Shulman's theory of pedagogical content knowledge (PCK) (Lye, 2013, p. 296).

According to Carlson (1999), Shulman developed the term pedagogical content knowledge (PCK) in the 1980s to address a gap in education research regarding missing content. Since then, educational researchers have shifted their focus to the 'missing paradigms'. This movement emphasized the professionalization of teaching (Shing, Saat, & Loke, 2015).

And TPACK is the foundation of effective technology-based teaching. It involves understanding how to represent concepts using technology, pedagogical techniques that use technology to teach content, understanding what makes concepts difficult or easy to learn, and how technology can address learning challenges. It also involves understanding students' prior knowledge and epistemological theories, as well as knowing how to use technology (Koehler & Mishra, 2009, p. 66).

The Technological, Pedagogical, and Content Knowledge (TPACK) model addresses the challenges of integrating ICT into teaching and learning by instructors and academic staff. The TPACK model focuses on academic staff's knowledge of integrating technology into teaching and learning environments. Academic staff's knowledge encompasses pedagogy, content, and technology. The TPACK model focuses on the complex intersection of academic staff's basic knowledge. The TPACK model emphasizes the basic knowledge of academic staff and education policymakers in incorporating ICT into teaching and learning processes (Lye, 2013, p. 296). This is related to Jang & Tsa (2013)' statement that Technological pedagogical and content knowledge (TPACK) is one of the leading theoretical concepts widely used by researchers to examine and develop teachers' knowledge of incorporating technology into teaching (Jang & Tsa, 2013, p. 566).

This paper investigates the theoretical foundations of TPACK, its implementation in educational settings, and its practical applications.

The Components of TPACK

The Technological Pedagogical Content Knowledge (TPACK) consist of three primary components:

1. Content Knowledge (CK)
   According to Shulman (1986), content knowledge can be just as ineffective as skill-free content pedagogically. To effectively balance a teacher's capacities, it's important to prioritize both content and process aspects. Content knowledge refers to the teacher's mental organization of knowledge. There are several approaches to representing content knowledge, including Bloom's cognitive taxonomy, Gagne's learning styles, Schwab's distinction between substantive and syntactic knowledge structures, and Peters' parallel ideas (Shulma, 1986, p. 9).

2. Pedagogical Knowledge (PK)
   Auerbach & Andrews (2018) stated that pedagogical knowledge encompasses general teaching and learning concepts, including learning theory, classroom management, and student motivation (Auerbach & Andrews, 2018, p. 1). Pedagogical knowledge (PK) refers to pedagogical knowledge that can be applied across multiple topics and disciplines. PK is less researched than PCK, resulting in a lack of clarity. According to Shulman (1987), Grossman and Richert (1988), Morine-Dershimer and Kent (1999), and König et al. (2014), a teacher's knowledge of learning theories, general principles and approaches to instruction and assessment, lesson structure, classroom organization and management, student motivation, and learner knowledge are all important (Auerbach & Andrews, 2018, p. 2).
3. Technological Knowledge (TK)
   Technological knowledge has its own abstract concepts, theories, rules, structure, and change dynamics that apply to real-world situations. Technological knowledge is derived from and embedded in human activity, as opposed to scientific knowledge, which is an expression of the physical world and its phenomena (Herschbach, 1995, pp. 32-33).
   Technological knowledge is necessary for creating and using technological artwork. The knowledge is of various types. Technological knowledge can range from hands-on experience in crafts to scientific knowledge in engineering. It is geared towards technological applications, including manufacturing and engineering design (Norström, 2014).

Theoretical framework

Punya Mishra and Matthew J. Koehler developed the TPACK framework in 2006. It emerged from the need to address how teachers can effectively integrate technology into their teaching practices, acknowledging that these areas of knowledge are interconnected. Thompson & Mishra (2007-2008) renamed the TPCK framework to TPACK (pronounced "tee-pack") to improve memory and integration of technology, pedagogy, and content knowledge (Schmidt, Baran, & Thompson, 2009, p. 123).

Mishra and Koehler’s model identifies three key components of teacher knowledge: content, pedagogy, and technology. The model emphasizes the interactions between PCK, TCK, TPK, and TPACK.

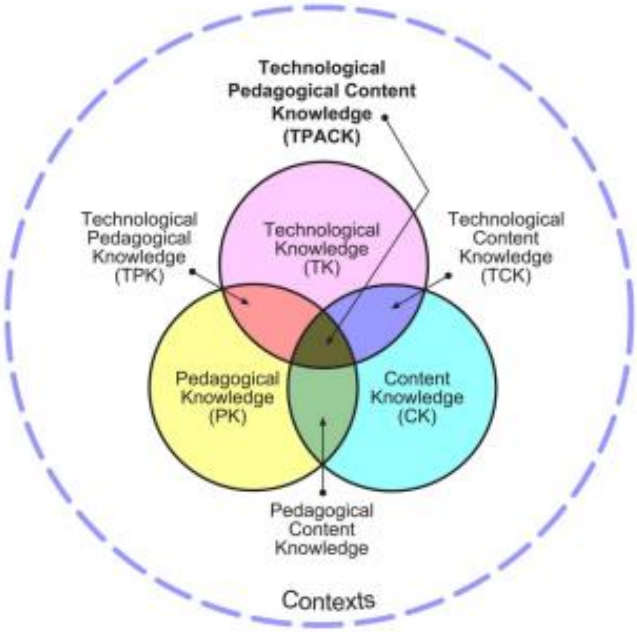

Figure 1. The TPACK framework and its knowledge components (Koehler & Mishra, 2009)

The TPACK framework expands on Shulman's concept of Pedagogical Content Knowledge (PCK) to incorporate technology knowledge alongside content and pedagogical knowledge (Schmidt, Baran, & Thompson, 2009, pp. 123-124). The TPACK framework contains seven components, as demonstrated in Figure 1. They're defined as:

1. Technological knowledge (TK)
   According to Giones and Brem (2018), technological knowledge connects individuals with scientific knowledge and innovation, promoting the growth of digital economies (Salas-Guerra, 2021).
2. Content knowledge (CK)
   Content knowledge refers to a teacher's core understanding of a specific subject or content area. According to Darling Hammond (2008), effective teaching requires teachers to have strong content knowledge (Kultsum, 2017, p. 56).
3. Pedagogical knowledge (PK)
   According to Shulman, pedagogical knowledge encompasses knowledge, theories, and beliefs about teaching and learning, which shape teachers' approaches to delivering a subject in class. The learning process includes activities such as material development, classroom management, problem-solving, methodology, strategy, and assessment (Kultsum, 2017, p. 56).
4. Pedagogical content knowledge (PCK)
   Pedagogical content knowledge encompasses the most commonly taught topics in a subject area, as well as effective representations such as analogies, illustrations, explanations, and demonstrations. Pedagogical content knowledge encompasses understanding what makes a topic easier or more difficult to learn, as well as the misconceptions and preconceptions that students of various ages and backgrounds bring to the most commonly taught topics (Shing, Saat, & Loke, 2015, p. 43).
5. Technological content knowledge (TCK)

Slough & Connell (2006) stated that technological content knowledge is a theoretical framework that emphasizes the "total intersection" of technology and content (Koehler, Mishra, Kereluik, Shin, & Graham, 2014, p. 103).

6. Technological pedagogical knowledge (TPK)
   According to Niess (2011), technological pedagogical knowledge (TPK) includes understanding the impact of technology on teaching and learning, as well as its benefits and limitations for pedagogical design and strategies (Mutiani, Supriatna, Abbas, Rini, & Subiyakto, 2021, p. 139).
7. Technological pedagogical content knowledge (TPACK)
   The Technology Pedagogy Content Knowledge (TPACK) framework integrates the ability to master technology into a series of learning components (C, P, and K). TPACK involves multiple interactions and combinations of components, including ICT-based subject matter, pedagogy, and technology (Malik, Rohendi, & Widiaty, 2018, p. 499).

Applications of TPACK in Education

Research has indicated that educators who apply the TPACK framework are more capable of creating lessons that are both engaging and effectively integrate technology. Teachers can, for example, build interactive learning environments that improve student understanding and engagement by carefully choosing technological tools that complement their lesson plans and pedagogical approaches (Harris & Hofer, 2011).

Teachers who want to implement the TPACK model in their classrooms must create lessons that successfully integrate technology, pedagogy, and content. For instance, in order to assist students in visualizing complex equations, math teachers may employ graphing software. Digital storytelling resources can get language learners interested in creative writing assignments. Teachers must, however, be knowledgeable in all three areas and constantly adjust to technological advancements in order to implement TPACK (Harris, Mishra, & Koehler, 2009, pp. 395-396).

According to Rohmitawati, the TPACK framework was put into practice using an online course that demonstrated the integration of multiple technologies, including GeoGebra, and an inquiry-based learning pedagogical approach to the subject matter of quadrilateral properties and quadrilateral broad formulas. For a deeper comprehension of quadrilateral concepts, the course also included the use of virtual manipulatives in the

form of online geoboard and tangram. By using technology, users were able to create their own knowledge and engage in interactive activities (Rohmitawati, 2018, p. 64).

Framework TPACK	Description
Content (C)	Analysis of quadrilateral properties, area of quadrilateral.
Pedagogy (P)	Discovery learning.
Technology (T)	GeoGebra.
Pedagogical Content Knowledge (PCK)	Discovery learning, as a pedagogical strategy for investigating quadrilateral properties and the area of a quadrilateral.
Technological Content Knowledge (TCK)	Using GeoGebra for investigating quadrilateral properties and the area of a quadrilateral.
Technological Pedagogical Knowledge (TPK)	GeoGebra for facilitating discovery learning.
Technology, Pedagogy and Content Knowledge (TPACK)	Integration of GeoGebra with a discovery learning pedagogical strategy for teaching quadrilateral content.

Table 1. the example of design implementation of TPACK framework (Rohmitawati (2018))

On other hand, Guntari & Jatmika (2023) implicated learning video media, Google Classroom, Flipbook, and Quizizz for the application of technological pedagogical content knowledge (TPACK), Even though learning is conducted with ever-more-advanced technology, education must play an active role as a facilitator to ensure that students continue to play an active role in the process. Teachers must continue to play an active role in education (Guntari & Jatmika, 2023).

According to Estaji et al. (2019), TPACK is used effectively when teaching English. For instance, grammar is taught by conducting online research, summarizing the material in eye-catching notes with examples, and then presenting the information in class. For instance, teachers meet to teach the material on “recount text” using Microsoft Teams, a feature integrated into the notebooks. In order to check their pronunciation, teachers ask students to record their voice during reading assignments. Instructors can employ task-based learning techniques by assigning questions to students through Microsoft Teams' assignment feature (Susanti, 2022, p. 32).

Yatun et al (2021) examined two teachers whom combined several other technologies, in addition to use the ED platform's single technology tool, including PPT, Google Classroom, Kahoot, and WA, during the teaching and learning process. Instructors assisted students in their work by providing various technological tools for various objectives. Instructors posted multiple questions or files on GC to introduce the topic, and then used PowerPoint to present and explain it. At the conclusion of the activity, teachers used Kahoot to assign a topic-related quiz to the students. Teachers reminded students to

complete the practice before concluding the activity. supplied in the home ED platform (Yatun, Munir, & Retnaningdyah, 2021, pp. 26-27).

On other research, the teacher was delivered study materials, which “Suggesting and Offering help”. The students were instructed to set up a group called *http://t.me/ximmaaye* and to install Telegram apps on their phones. The purpose of the group was to facilitate communication between students and teachers. The students, teacher, and the Telegram group communicated with one another and exchanged assignments and pictures. Teachers don't need to save the students' names in Telegram because their names appear automatically. Therefore, in order to provide feedback or express gratitude regarding a job well done or other assignments, the teacher can click on the student's name in the Telegram group if they would like to speak with them privately (Aisyah , Setiawan, & Munir, 2021, p. 24).

Advantages of TPACK

In order to improve the learning process and encourage creativity and innovation, educators are currently required to design learning that is integrated with ICT. Technology, curriculum, and the learning environment must all be integrated into the TPACK framework by teachers. Although they are not as effective as they were prior to the pandemic, problem-based and project-based learning models can still be used. Sadeghi (2019) stated that distance learning offers numerous benefits and limitless opportunities for the future. Related to Sadikin & Hamidah (2020) that for educators, the biggest benefit is that students can learn at any time and from any location (Juanda, Shidiq, & Nasrudin, 2021, p. 54).

Developing a framework for efficient technology integration into teaching and learning is essential as technology in education advances. Here the advantages of technology integration with the TPACK model:

1. Encourage engagement and learning
   The TPACK model enables educators to design dynamic and interesting learning environments by combining technology, content, and pedagogy. When technology is used in the classroom, students engage with the material in more relatable and immersive ways. For instance, utilizing virtual field trips or science simulations can pique interest and deepen understanding (HeyHi Admin, 2023).
2. Encourages teacher growth
   TPACK helps educators learn how to strike a balance between content knowledge, pedagogy, and technology. It gives teachers a methodical way to keep up with technology advancements and update their teaching strategies, which increases their efficacy in the classroom (HeyHi Admin, 2023).
3. Prepare students for a digital future
   Since technology permeates every aspect of contemporary life, TPACK assists students in acquiring the digital literacy and problem-solving abilities that will be essential for success in the future. The framework makes sure that students are critical thinkers who can adjust to new technological tools rather than just passive consumers of technology (Lynch, 2023).

Challenges and Limitations of the TPACK Model

Several important problems with the TPACK model's intricacy and usefulness are among its challenges and limitations, they are:

1. Complexity and Operation
   One of the main complaints is that TPACK can be unduly complicated, especially for teachers attempting to incorporate it into their curricula. It can be difficult for teachers to tell apart technological, pedagogical, and content knowledge when creating lessons because of the multiple intersections between these domains. Because of its complexity, some educators find the model difficult to understand or challenging to apply successfully in practical settings (EdTech Classroom, 2021).
2. Teacher training and professional development
   One of the main issues is that not all educators have received sufficient training in technology, and the TPACK model necessitates a thorough comprehension of the ways in which technology interacts with content knowledge and pedagogy. To fully implement the TPACK model, teachers frequently require ongoing professional development, which can be resource-intensive for schools (EdTech Classroom, 2021).
3. Lack of empirical support and scientific usefulness
   Teachers working in the field may find it difficult, misleading, and confusing to sort through the finer points of TK, PK, CK, TPK, PCK, TCK, and TPACK in order to move forward with the design of learning units, even though some academics view TPACK as a universal model for curricula design. Pedagogy, content, and technology were not able to be independently verified by Archambault and Barnett (2010) in their empirical study of 596 online teachers in the United States. Technology was the one area where it stood out from the rest (Kompa, 2018).
4. Resource Availability
   The effective application of TPACK frequently depends on getting access to resources and technology, which may not be universally available in educational settings. The inability of schools with inadequate technology infrastructure to implement TPACK successfully can increase the digital divide between institutions with adequate and inadequate resources (Kendon & Anselmo, 2024)
5. TPACK is not Generally Applicable
   According to some researchers, TPACK is not always relevant in all subject areas. It can be challenging for educators to integrate technology in fields where it is less prevalent, which lessens the model's applicability or usefulness in those situations (Kendon & Anselmo, 2024).

Conclusion

The TPACK framework is a comprehensive model that gives teachers the instruments and direction they need to successfully incorporate technology into their lesson plans. Teachers can improve student engagement and foster deeper learning by combining their pedagogical knowledge (PK), technological knowledge (TK), and content knowledge (CK). Nevertheless, the model is not without its difficulties. Its practical implementation may be hampered by its complexity, the requirement for ongoing professional development, and unequal access to technology. Despite these limitations, TPACK is still a vital framework for the continuous development of education, especially as the significance of digital literacy grows. With careful implementation and continued assistance, TPACK can enable educators and learners to flourish in a technologically advanced classroom.

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