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TEACHER PROFESSIONAL DEVELOPMENT IN THE PERSPECTIVE OF TECHNOLOGY PEDAGOGICAL CONTENT KNOWLEDGE THEORETICAL FRAMEWORK

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Abstract

Teacher development is an ongoing process through which teachers keep growing with their capabilities. They must be adaptive to the demands of changing times and open to self-professional development. Today, teacher development is challenged to develop not only mastery of science and teaching abilities but also technology. In the perspective of Technology Pedagogical Content Knowledge (TPACK), the meeting of these three competence dimensions can be further divided into seven sub-competencies: technological knowledge, pedagogical knowledge, knowledge of course content, technological pedagogical knowledge, technological content knowledge, pedagogical content knowledge, and technological pedagogical content knowledge. This paper ends with pedagogic implications for teacher professional development that demands high quality and perceived as valuable.

Keywords: Teacher Professional Development, Teacher Learning, Technology

INTRODUCTION

Providing top service to stakeholders (students, parents, and society) is indeed a representation of dedication and professionalism and a call for teachers. If teachers want to be professional, they must adapt to the demands of changing times and be open to self-professional development. For example, teachers who are accustomed to teaching traditional face-to-face classes, must be able to teach their students using technology, especially during the current pandemic. Teachers are asked to place greater emphasis on integrating students with special learning needs in their classrooms, make more effective use of information and communication technologies for teaching, engage more in careful teaching planning within evaluative and accountability frameworks, and collaborate with colleagues and parents to promote meaningful learning.

In short, teacher professional development can be interpreted as significant improvement in teacher performance that leads to impactful results for the students, institutions, and even for their own career. Nevertheless, the definition of teacher professionalism is quite general. The definition of a professional teacher is debatable and even subject to criticism. For example, Mitchell (1997) found a debate between policymakers in higher education institutions and the administrative management section about the elements of teacher professionalism to determine teacher certification. This debate is presumably induced by the fact that 50% of these teachers teaching in universities teach content courses (Mitchell, 1997). The content courses are related to mastery of knowledge about specific disciplines such as science, humanities, social, etc.

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Shulman (1987) said that teachers must have mastery of the content knowledge of a course (content knowledge/CK) and mastery of pedagogical knowledge (pedagogical knowledge/PK). According to Shulman (1987), these two things lead teachers to the right strategy to encourage students to achieve academic achievement, thus they are inseparable. The mastery of content knowledge (CK) is the teacher's knowledge of the subject matter to be studied or taught. This knowledge includes knowledge of concepts, theories, ideas, organizational frameworks, evidence and evidence, and established practices and approaches for developing that knowledge. Each field has its unique method of research. For example, in the case of science, the research methods include knowledge of scientific facts and theories, the scientific method, and evidence-based reasoning. In terms of art appreciation, knowledge of science includes knowledge of the history of art, famous paintings, sculptures, artists, and their historical context, and knowledge of aesthetic theory and psychology to evaluate art.

Meanwhile, pedagogical knowledge (PK) is related to mastery of knowledge about teaching and learning processes and practices/methods. This knowledge mastery applies to understanding how students learn, general skills in classroom management, lesson planning, and student learning assessment. Teachers must understand the knowledge of techniques or teaching methods used in the classroom, the nature of the learners, and strategies for evaluating student understanding. A teacher with deep pedagogical knowledge understands how students build knowledge, acquire skills, develop thinking habits, and have positive perceptions of learning. Thus, pedagogical knowledge requires an understanding of cognitive, social, and developmental learning theories and how these theories are applied to classroom teaching.

Based on Shulman's theoretical framework, Koehler and Mishra (2005) introduced technology in education which further added technological knowledge as a critical component. By adding elements of technological knowledge to the two previous component areas, mastery, of course, content knowledge, and pedagogic knowledge, Mishra and Koehler (2005) introduce three essential components of teacher professionalism: CK, PK, and TK. This theoretical framework is the result of a five-year study by Mishra and Koehler (2006), in which they focused on teacher professional development and faculty development in higher education. Mishra and Koehler (2006) assert that it is necessary for teachers to introduce technology into the educational process and not enough on "what teachers need to know to incorporate technology into their teaching." From the thoughts of Mishra and Koehler (2006), the term TPCK emerged.

In its development, Thompson and Mishra (2007) changed TPCK to TPACK to articulate component or domain linkages more accurately. Over time, the term TPACK is increasingly popular among researchers. For example, Schmidt et al. (2009) developed the TPACK instrument to measure the self-assessment of prospective teachers within the TPACK framework. They further emphasized that the framework has the potential to impact the type of training and professional development of both teachers. The meeting between technological knowledge, content knowledge, and pedagogic knowledge gave birth to seven sub-competence deviations as follows:

1. Technological Knowledge (TK) – knowledge of technology equipment/applications. The examples of technological knowledge are the ability to create/utilize web pages, the ability to use social media applications, and several other applications for learning purposes such as creating collaborative learning activities, encouraging communication with students, facilitating students take digital notes for

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learning, assist students in developing ideas, and help students visualize the results of their thoughts.

2. Pedagogical Knowledge (PK) – knowledge of teaching methods. The following are examples of pedagogical knowledge. For example, teachers can expand students' thinking by designing challenging assignments for them, guiding students to adopt appropriate learning strategies, helping students to monitor learning independently, helping students to reflect on strategies for their learning, planning group activities for students, and guiding students to discuss effectively during group work.

3. Knowledge of course content (Content Knowledge/CK) – knowledge of course material/lessons. The following are examples of content knowledge, such as having and mastering subject content knowledge and developing students' more profound understanding of subject content.

4. Technological Pedagogical Knowledge (TPK) – knowledge of using technology to apply teaching methods. The following are the examples of pedagogical knowledge of technology, such as the ability to use technology to introduce students to real-world scenarios, facilitate students to use technology to find more information and plan and monitor learning independently, help students to use technology to build various forms of knowledge representation, and encourage students to collaborate using technology.

5. Technological Content Knowledge (TCK) – knowledge of the representation of subject matter with technology. The following behaviors represent knowledge of technology content, such as the ability to tailor-made software for the course/course and the ability to utilize technology to support research in the course/course.

6. Pedagogical Content Knowledge (PCK) – knowledge of teaching methods concerning subject matter content. For example, teachers can overcome the misconceptions students have in the course, know how to choose a practical teaching approach to guide students' thinking and to learn in the course/lesson, and help students to understand the content of courses/lessons taught in various ways.

7. Technological Pedagogical Content Knowledge (TPACK) - using technology to apply constructivist teaching methods to different subject matter content.

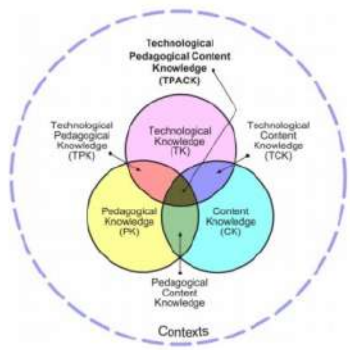

Figure 1. The theoretical framework of TPACK

The Following are examples of behaviors reflecting technology pedagogical content knowledge: formulating in-depth discussion topics about content knowledge from courses/lessons, facilitating students to collaborate online with appropriate apps, being able to design authentic issues about content knowledge, making use of computers/apps to engage students, organizing activities to help students build a variety of information using appropriate ICT tools, and creating independent learning activities from appropriate subject knowledge.

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TPACK AND CONSTRUCTIVISM

Hannafin, Land, and Oliver (1999) added the importance of ICT tools to support students learning in authentic problem contexts. Students perform information manipulation, problem visualization, and metacognition. The same thought about the interaction between ICT use and the practice of constructivism learning is also of the same mind as Mikropoulos and Natsis (2011) and Tsai (2004). Jonassen, Howland, Marra, and Crismond (2008) further develop the principles that underlie ICT-supported constructivist learning.

The constructivist learning dimension with ICT first demands activity on all students. Through this competency, students are encouraged to utilize learning resources from technology platforms and use them for learning purposes. Second, the nature of learning should be constructive in that the teacher engages students to self-evaluate and articulate their understanding of their observations. Third, ICT-based learning involves students in authentic tasks based on real-world problems. Fourth, students must have an inner drive to set their learning goals and plan their problem-solving process. Fifth, ICT-based constructivism learning occurs like a social process that involves collaborative problem-solving in the classroom community. Jonassen et al. (2008) called the five dimensions developed as "engagers and facilitators of thinking." Therefore, these five dimensions can be used to understand the constructivist-oriented TPACK of teachers.

TPACK as an instrument to measure teacher performance

TPACK allows teachers to consider what knowledge is needed to integrate technology into teaching and how they can develop that knowledge within themselves. Mishra and Koehler (2006) apply this framework to the training and education of prospective and working teachers.

TPACK is also understood as an instrument to measure the degree of integration of the main components of the TPACK framework and the subdomains contained in the TPACK instrument. As a measuring tool, the TPACK framework assesses how far a person knows how to effectively integrate technology into the curriculum (i.e., teacher practice), and it is a combination of CK (Content Knowledge), PK Pedagogical Knowledge, and TK (Technology Knowledge) which are mutually exclusive related.

Several researchers have tried to build a TPACK instrument (Schmidt et al., 2009; Graham et al., 2009; Archambault & Crippen, 2009; Lee & Tsai's, 2010; Chai, Koh, Tsai, & Tan, 2011). The seven TPACK constructs were validated with an adequate fit model. The following is an example of a questionnaire adopted and adapted from the instrument Koh, Chai and Tsai (2014).

Table 2. Technology Pedagogical Content Knowledge Questionnaire

Dimensions	Indicators
Technological Knowledge/TK	I can create web pages.
	I can use social media apps (eg, blogs, Wikis, Facebook).
	I can use collaboration apps (eg, Google Sites, CoveritLive).
	I can use apps for communication (eg, VoiceThread, Podcasts).
	I can use apps for online note taking (eg, Diigo, Wallwisher).
	I can use the app for the development of ideas/thoughts mind tools (eg, Webspiration, Mindmeister).
	I can use apps for visualization (eg, Wordle, Quizlet).

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Pedagogical Knowledge/PK	I can broaden students' thinking by designing challenging assignments for them.
	I can guide my students to adopt appropriate learning strategies.
	I can help my students to monitor their own learning.
	I can help my students to reflect on their learning strategies.
	I can plan group activities for my students.
	I can guide my students to discuss effectively during group work.
Content Knowledge/CK	I have sufficient content knowledge about the subject.
	I am very well versed in the subjects / content lessons that I am capable of
	I can develop a deeper understanding of the courses / content lessons that I am capable of.
Pedagogical Content Knowledge/C-PCK)	Without using technology, I can overcome common misconceptions that my students have for the courses I teach.
	Without using technology, I know how to choose an effective teaching approach to guide students' thinking and learning in my course/course.
	Without using technology, I can help my students to understand the knowledge of the content subjects I teach in various ways.
Technological Pedagogical Knowledge/TPK	I can use technology to introduce my students to real-world scenarios.
	I can facilitate my students to use technology, so they find more information on their own.
	I can facilitate my students to use technology to plan and monitor their own learning.
	I can facilitate my students to use technology to construct various forms of knowledge representation.
	I can facilitate my students to collaborate with each other using technology.
Technological Content Knowledge/CK	I can use custom made software for my first subjects. (For example, electronic dictionaries/corpus for languages; Geometric sketches for Mathematics; Data loggers for science)
	I know about the technology I should use to research the courses I am teaching
Technological Pedagogical Content Knowledge/TPACK)	I can formulate in-depth discussion topics about the knowledge of the subject and facilitate student collaboration with appropriate apps. (e.g., Google Sites, CoveritLive)
	I can design authentic problems about content knowledge through computers involving my students.

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	I can structure activities to help students build diversity of information using relevant ICT tools (eg, Webspiration, Mindmeister, Wordle).
	I can make independent learning activities from the knowledge of the subject appropriately

RESEARCH TPACK

TPACK attracts many researchers to further explore the interrelationships of its elements. The following is a summary of several research results from 2009-2013 on TPACK. Over time, the term TPACK is increasingly popular among researchers. For example, Schmidt et al. (2009) developed the TPACK instrument to measure the self-assessment of prospective teachers. They further emphasized that the framework has the potential to impact both teacher training and professional development. Several researchers have investigated the construct quality of the TPACK-validated instrument (Schmidt et al., 2009; Graham et al., 2009; Archambault & Crippen's, 2009; Chai, Koh, Tsai, & Tan, 2011).

Shin et al. (2009) found that more and more teachers understand the complex relationship between technology, pedagogy, and content. There are better opportunities to develop effective technology integration into the curriculum for teachers. Cox and Graham (2009) found that knowledge of pedagogical content is specific pedagogy, not knowledge of general pedagogical methods. Technological knowledge is focused on emerging technologies. Jimoyiannis (2010) found that students' technological abilities improved while most teachers were still at a lower level using technology tools rather than integrating tools into pedagogical applications.

Koh, Chai, and Tsai (2010) said the relationship between gender and trust in the use of technology. Meanwhile, Archambault and Barnett (2010) found a relationship between technical content knowledge and technology pedagogy. Allan, Erickson, Brookhouse, & Johnson (2010), researching secondary school science teachers, found an increase in teachers' understanding of technical skills in general. According to the teacher, the integration of technology is effective in various ecological curricula, stimulating learning motivation and increasing student involvement in teaching and learning activities.

Harris & Hofer (2011) found that content-based learning using technology is in line with existing teaching needs. Lux, Bangert, & Whittier (2011) say that the TPACK assessment of prospective teachers is very important to evaluate the competence of technology integration in the educational environment and evaluate the quality of instructional technology training in teacher preparation programs. Kohen & Kramarski (2012) examined secondary school teachers that the TPACK framework can help guide the way teachers view the interaction of technology, pedagogy, and content. Linton (2012) found that the aim of all instructional support positions is to enhance instruction to enhance student learning by involving teachers and librarians as research subjects. Librarians can play an important role in the integration of digital technology into student learning. Roblyer & Doering (2013) found that educators realized that technology skills alone did not help them well because one could know how to operate technology without knowing how to use it effectively to encourage student learning.

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Table 3. The summary of research on TPACK

Researchers	Population	Research Method	Results
Shin et al. (2009)	Online instructor at K-12 . level	Surveys; Pearson's product-moment correlation	More and more teachers understand the complex relationship between technology, pedagogy, and content; there are better opportunities to develop effective technology integration into the curriculum for teachers.
Cox dan Graham (2009)	Prospective teachers in introductory instructional technology courses	surveys; factor analysis	Knowledge of pedagogical content is specific pedagogy and not general knowledge of pedagogical methods. Technological knowledge is focused on emerging technologies.
Jimoyiannis (2010)	Science teacher preparation program	Qualitative approach	Students' technological abilities are improving while most teachers are still at a lower level on how to use technology tools than integrating tools into pedagogical applications.
Koh, Chai, dan Tsai (2010)	1185 Taiwanese teacher candidates in Singapore	Construct validity and perception of TPCK/TPACK	There is a gender relationship with the level of trust in technology use.
Archambault dan Barnett (2010)	Online teachers across the United States	Construct validity and perception of TPCK/TPACK	There is a relationship between technology content knowledge and technology pedagogy. The domain of the TPACK framework is still not clearly understood.
Allan, Erickson, Brookhouse, & Johnson (2010)	High school science teacher	Project activities and expert evaluation	There is an increase in teachers' understanding of computer simulations and models, an increase in general technology skills. According to the teacher, technology integration is quite effective in various ecological curricula, and it is a powerful way to stimulate learning and increase student involvement in learning the material.
Harris & Hofer (2011)	Intermediate social studies teacher	Qualitative interview data and planning product analysis	A content-based activity type approach to technologically inclusive instructional planning is compatible with existing teaching approaches

Lux, Bangert, & Whittier (2011)	Teacher candidates enrolled in educational technology programs	survey; exploratory factor analysis	Assessing the TPACK of prospective teachers is important not only to evaluate the competence of technology integration in the educational environment but also to evaluate the quality of instructional technology training that occurs in teacher preparation programs.
Kohen & Kramarski (2012)	Israeli pre-service secondary school teacher in teaching and learning methods subjects	Coding levels, two-dimensional mapping, citations, and benchmarks; one-way MANOVA; single group pretest-posttest	the TPACK framework can help guide the way teachers view the interaction of technology, pedagogy, and content, and that the instrument is flexible, valid, and reliable.
Linton (2012)	Teachers and librarians	Collaborative workshop	The goal of all instructional support positions is the improvement of instruction to enhance student learning. Librarians can play a key role in the integration of digital technology into student learning
Roblyer & Doering (2013)	Teacher	Tech-PACK and technology integration platform	Educators realize that technical skills alone do not help them well because one can know how to operate a technology without knowing how to use it effectively to encourage student learning.

CONCLUSIONS AND IMPLICATIONS

In the perspective of TPACK, teachers must be able to motivate and upgrade themselves to be competent in pedagogics, content knowledge, and technology. Thus, professionalism is a continuous process through active participation in practice. Teachers cannot fight alone to achieve this goal, but they need to get support from various parties. For example, schools must view teacher professional development as an important program that must be supported through measurable programs. Education systems therefore seek to provide teachers with opportunities for in-service professional development to maintain a high standard of teaching and to retain a high-quality teacher workforce. It can be made available through external expertise in the form of courses, workshops, or formal qualification programmes, through collaboration between schools or teachers across schools (e.g., observational visits to other schools or teacher networks) or within the schools in which teachers work.

Teachers must continue to build awareness to involve themselves cognitively and emotionally in their development. Teachers must develop a habit of reflection on their own experiences and the

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experiences of others. Reflection is within professional development activity fraught with issues associated with teacher confidence and skill in reflective action. They need to interact with each other and share good experiences about teaching. When teachers become aware of their practice, there is an opening for change. The key is awareness. Reflection results in strengthening professional self-awareness that is a major concern in teacher development processes. It leads to transferring methods for systematic reflection on teaching practice.

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