MEASURING TPACK SKILLS OF ELEMENTARY SCHOOL TEACHERS:

KESIAPAN MENGAJAR ILMU PENGETAHUAN DI ERA BLENDED-LEARNING

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Article Info	Abstract
	The science learning process has changed from classroom to online education. This leads to blended learning-based learning in a relatively short amount of time today has many challenges and burdens on teachers. Motivation to direct the learning process is important to understand how technology can prepare teachers' abilities in the future, which is an integral part of the learning process. This research aims to measure the willingness of elementary schools in different parts of Indonesia to practice blended learning. This research is descriptive and quantitative research. The survey was conducted although it needs improvement in mastering the Technological Knowledge. There are 64 elementary school teachers with 1 to 10 years of teaching experience in the 16 regions of Indonesia, who are currently in the teacher training program at Sultan Ageng Tirtayasa University. The survey results show that the teachers' ability to use each component in the TPACK is generally categorized as "very good", which can be concluded that the elementary school teachers are considered capable of implementing the blended learning process. This description can be used as a benchmark to develop the teachers' ability to improve the quality of the learning process and coexist with technological developments. Keywords: Blended-learning; teacher competencies; online education; technology; TPACK

A. Introduction

Since 2020, the Indonesian learning and education process has rapidly changed, the Covid-19 pandemic, digitalization era, and Outcome-Based Learning applications become the biggest factor toward changes that occur in the learning process in the classroom. Currently, the classroom is not only referred to the form of traditional face-to-face classes but also online classes that rely on information technology. The transition to online education, especially in elementary schools, creates problems in the form of reduced learning effectiveness (Faturohman, 2021). Moreover, educators agree that technology can no longer be treated as a separate body of knowledge that is isolated from the pedagogical and content knowledge that teachers require. In order to respond to the needs, teachers not only should focus to develop skills on how to use technology but also learn about how technology can be used for the teaching and learning process.

This situation is a formidable challenge for teachers, as they have to develop their abilities and compromise with a lack of infrastructure in providing the proper science learning using technology. Teachers are starting to use various online platforms to support learning, such as WhatsApp, Zoom, Google Meet, and television channels (Dahlan, 2021). While the teacher education programs recognize the importance of technology integration, the same program helps to find effective programs and classroom-level strategies that properly prepare teachers to integrate technology into the future classrooms (Wei, *et al,* 2018). It is TPACK, which stands for Technological Pedagogical Content Knowledge which was introduced by Mishra and Koehler in 2006. This concept provides a common language in talking about teaching, learning, and technology. This framework emphasizes the connections, interactions, affordances, and constraints between and among content, pedagogy, and technology. As a basic framework for teaching competencies in the 21st century, TPACK represents a complete relationship between knowledge, technology, educational skills, and content (Farikah et al., 2019). Research by Balan et al. (2011) shows that TPACK

can also be used as a measurement of the teachers' willingness to perform learning in parallel with the technology that is very much needed today. The TPACK framework combines three basic aspects of the skills that teachers need to provide learning materials and use technology to manage their teaching (Chai, 2020). Content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK) are the essential skills that must have by teachers. In addition, these three pillars need to be integrated to achieve educational goals. When these three types of knowledge overlap, the four types of knowledge of PCK, TCK,

TPK, and TPACK are also created (KY Huang, et al.2020). The figure 1 shows the connections on all sides of the TPACK.

The first and most valuable skill a teacher should have is Pedagogical Content Knowledge (PCK). Today's teachers need to creatively interweave PCK with technical knowledge to design a lesson plan for reinforcement learning to form TPACK. Besides that, we need to overcome the new classroom situations caused by technology limitations such as bandwidth limitations and student preparation.
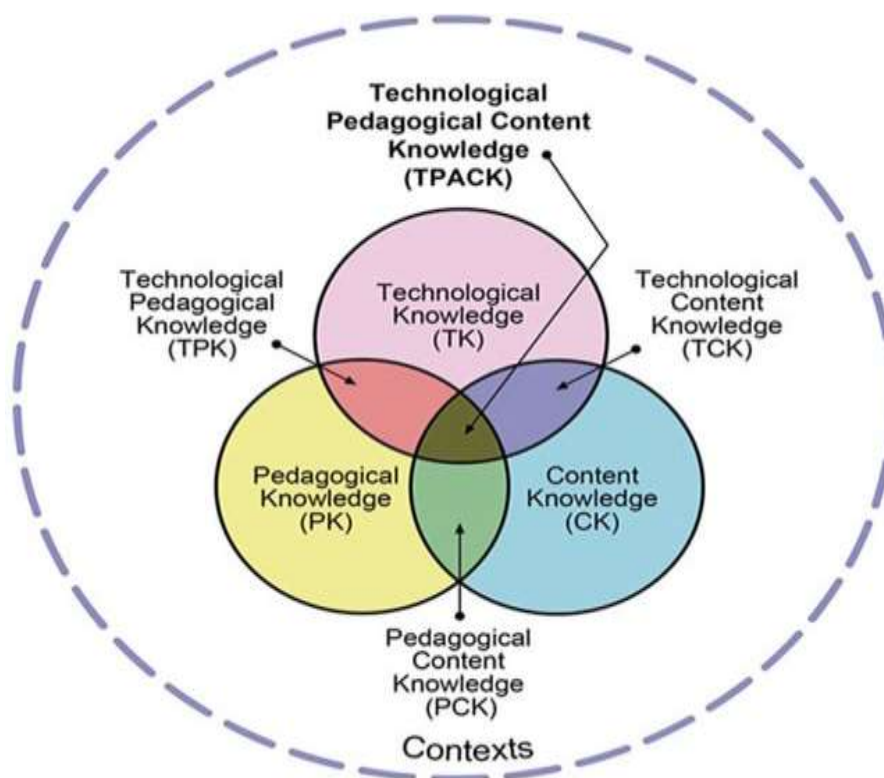
Figure 1. The TPACK Framework
Source: Koehler & Mishra, 2009

Technological content knowledge (TCK) represents the knowledge of the technological tools and representations that are used by practitioners within a content discipline (such as due to the use of data collection and analysis tools such as digital probes and spreadsheets by scientists) (Tanak, 2020). One of the skills that must be built is about how teachers have the skills to finds and deliver content using the technology. Choosing the best ICT program to deliver content as how they use the program effectively to explain the material is the skills required in the TCK dimension. TPK represents the integration of technology with common pedagogical strategies (such as the way to manage a technology-rich classroom, engage students with technology-oriented activities, and make presentations and assessments). Lastly, TPACK, which is at the middle of the model, represents the use of technology to support specific content in pedagogical strategies.

Blended learning is a term that refers to a learning process that combines the traditional face-to-face learning process and online learning (Hocly, 2018). The learning process with the concept of blended learning should have components in the form of a curriculum that is designed for both face-to-face and online meetings, as well as the learning resources and instructions designed to use both learning processes to support the full-learning experience. Online meetings can also be used as the reinforcement and deepening of material outside the offline classes (Hrastinski, 2019). Blended learning is also used to describe other blends, such as different teaching methods, pedagogical approaches, and combinations of technologies, but these blends are consistent with the most influential definition of blended learning. Blended learning offers flexibility, educational diversity, and cost-effectiveness. It also guarantees valuable interaction and participation in learning. It is considered valuable for learners of various types (Rasheed, 2019).

Blended learning combines two educational components (face-to-face

and online components) into one whole process, where the students and teachers automatically transition to online learning by not ignoring the face-to-face component (Graham, 2006). Therefore, teachers should expect to work properly, self-adjust, and perform tasks at their own pace with the help of technology.

Although blended learning is considered the best practice to deliver science content to elementary school students nowadays, there are many aspects that need to be developed. The teachers' ability to provide learning through technology is the most crucial factor to be developed. Unfortunately, current research is still not unclear about the teachers' readiness if teachers in Indonesia perform blended learning in their classrooms. Therefore, researchers are interested in conducting research to measure the elementary school teachers' readiness from various regions in Indonesia in implementing science education using the blended-learning method.

B. Research Methodology

This research is using descriptive quantitative method, to explain descriptive data on each component in TPACK. The data was collected by using Google Form as a tool to conduct a survey of 64 elementary school teachers spread across the various regions in Indonesia. Respondents are novice teachers who have been teaching for one to ten years and are currently pursuing professional education at Sultan Ageng Tirtayasa University. Respondents were selected randomly. The demographic of the respondent is described in table 1.

Surveys are typically used to obtain information about facilities that are difficult to measure using observational methods. Occasionally researchers use the surveys to obtain detailed information about elementary school teachers' opinions, beliefs, and demographics to measure their readiness to teach science in the blended learning method using seven aspects of TPACK.

Table 1
Demographics of respondents

Areas	Number	Gender		Age	Experience (Years)
		Female	Male		
Sumatera	13	8	4	27-41	1-10
Java-Bali	32	20	5	29-45	2-10
Kalimantan	6	6	6	27-32	3-10
Sulawesi	13	6	2	28-44	3-10
Nusa Tenggara	6	7		30-37	2-10

This research instrument consists of 14 questions related to TPACK and 3 questions related to the demographics of the teachers. The instrument was developed from various literatures to involve every aspect in the TPACK as shown in Table 2. Each aspect of TPACK is represented by two questions that have been tested for its reliability and validity.

Table 2
TPACK skills indicators

No	Skills	Questions
1	CK	I have understood the science material for elementary school students well
2		I am able to create science learning content for elementary students
3	PK	I can determine the appropriate science learning method according to the character of the students and the material being taught
4		I am competent in presenting science learning to students
5	TK	I understand the use of basic applications that support online learning
6		I can provide technology-based science teaching media
7	PCK	I can invite students to understand the relationship between concepts without using the media
8		I can facilitate students in understanding the scientific process
9	TPK	I am accustomed to using information technology in delivering learning materials to the students
10		I am able to conduct online class
11	TCK	I can create a learning resource using an IT program
12		I can decide which IT program suitable to deliver the learning content
13	TPACK	I am able to use technology to provide an understanding of science concepts

| 14 | I am able to invite students to interact in the learning using technology |

The analysis was conducted by measuring the average answer at the question indicators on every aspect of TPACK skills. The answer was then reviewed by the researcher in order to examine the teachers' readiness to deliver science content to the students using technology in a blended learning class.

C. Result and Discussion

Teachers in Indonesia, like the other educators in various countries, are certainly preparing to shift learning according to the latest technological developments. Various schemes for transitioning the learning process from learning methods in face-to-face classes to being familiar with the distance learning methods, but the Covid-19 pandemic has made changes to be implemented much faster (Sulisworo, Astuti, and Fatimah, 2020). At a very fast pace, teachers must be ready to carry out online learning to maintain the quality of learning and the outcomes of knowledge and skills do not decrease during the pandemic. In the long term, learning is directed to the form of blended learning, where the teachers need to master the flexible forms of teaching and learning processes using technology.

Measuring the teachers' readiness in carrying out the blended learning process can be viewed from the teacher's ability to master each aspect of TPACK. The exploration of the mastery of all components of TPACK is considered capable of providing a complete illustration of how the teacher will convey the material that has mastered, with the help of information technology as a tool for developing media and managing the classroom. A balanced teacher's ability to master Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK) is expected to help teachers master the technology-based classes completely in order to held blended learning classes. These aspects are categorized by the Likert scale developed by Widyonoko (Purnomo and Palupi, 2016). Each component is assigned a scale interval of 4 for each aspect (Table 3).

Table 3
TPACK criteria guidelines scoring

TPACK Variables	Interval	Categories
	$0,00<x\leq1,75$	Low
	$1,75<x\leq2,50$	Fair
	$2,50<x\leq3,25$	Good
	$3,25<x\leq4,00$	Very good

The data collected by the survey process is then analyzed with quantitative-descriptive analysis. The value of each component was analyzed to determine the description of the teacher's ability to master the components in TPACK which will be the provision in implementing blended learning-based learning. The results of the data processing are shown in Table 4 below.

Table 4
Data Processing Results

	CK	PK	TK	PCK	TPK	TCK	TPACK
Valid	124	124	124	124	124	124	124
Missing	0	0	0	0	0	0	0
Min	2	2	1	2	1.5	1.5	1
Max	5	5	5	4.50	5	5	5
St. Dev	.620	.597	.800	.600	.780	.676	.674
Mean	3.50	3.24	3.30	3.22	3,38	3.45	3.31
Category	Very Good	Good	Very Good	Very Good	Very Good	Very Good	Very Good
Total	217	212	206	200	210	214	205

The results of the analysis show that the ability of TPACK in implementing blended learning in various components is not significantly different. Generally, the teacher' ability in each TPACK component is categorized as "very good". A balanced understanding of each aspect of TPACK certainly shows that elementary school teachers who are participating in a teacher competency improvement program have a balanced ability in every aspect needed in the implementation of blended learning.

Content Knowledge (CK) is the most fundamental capacity required in the learning system, where an educator should master the ideas or information that will be instructed to the students. The mastery of learning content is stated in Law Number 14 of 2005 concerning Teachers and Lecturers that educators should have competent capacity. This means that an instructor should master the capability of the branch of knowledge being educated. From the overview results, it is realized that the CK viewpoint is classified as "Very good" with a normal score of 3.5. Mastery of CK by educators is the highest score among different points of view noticed.

With the ultimate goal to complete the learning system, collaborate with students, convey the science material in the class, an educator needs to comprehend the Pedagogical Knowledge (PK) (Rienties, 2013). The score of PK is insignificantly different from CK, where the score of the educators is 3.41. Another fundamental part connected with the media planning and assisting the performance system through a mixed learning instrument is Technological

Knowledge. This ability gives the instructors the adaptability to develop attractive learning media, oversee the online classes, and use the learning management system to cooperate with their students (Juanda, 2021; Brinkey-etzkom, 2018; Alayyar,2012). In any case, from the overview results, Technological Knowledge turns into the essential part with the smallest score of 3.24 and is categorized as "good". This can be seen as an indicator of the technological strength of the individuals who have acquired the skills to use technology to support learning and the learning process (Gestiardi, et al., 2021).

On the other hand, all skills born from the combination of CK, PK, and TK skills did not make a big difference and showed results that could be evaluated as "very good". In the Pedagogical Content Knowledge (PCK) component, the teacher's average skill value is 3.22. This means that elementary school teachers have a very good understanding of developing teaching materials, creating learning tools, implementing learning, and drawing conclusions. Likewise with the Technological Pedagogical

Knowledge (TPK) skills with a value of 3.38. This skill includes efforts to get the most out of information technology and learn through the blended learning classes. The ability to create media and present the learning content in blended learning classes using technology is represented by the Technical Content Knowledge (TCK) skill with a maximum score of 3.45. The application of PCK-related skills, especially for teachers in rural areas is become a big problem (Setiawan and Iasha, 2020). With limited funding, this is important to address in order to improve the learning process through blended learning.

The observed TPACK indicator of elementary school teachers also has a "very good" average value. This means that teachers already have sufficient capacity to integrate content, pedagogical aspects, and the use of technology in integrated learning processes such as blended learning. Teachers who master TPACK will be able to provide high-quality content as the technology develops (Meghed and Hasan, 2021; Rochintaniawati et al., 2019).

D. Conclusion

The teachers' ability to provide the teaching materials, manage classrooms, and coexist with technological advances is the foundation of blended learning style classroom management. Mastering the skills of each component of TPACK will help teachers prepare for competency and content-oriented learning. By measuring these skills, you can collect and improve teachers' readiness descriptions of the mixed learning process and improve the overall quality of education.

References

Alayyar, G. M., Fisser, P., & Voogt, J. (2012). Developing technological pedagogical content knowledge in pre-service science teachers: Support from blended learning. *Australasian journal of educational technology*, *28*(8).

Baran, E., Hsueh-Hua, C., & Ann, T. (2011). Tpack : an Emerging Research and Development Tool for. *The Turkish Online Journal of Educational Technology –*, *10*(4), 370–377.

Brinkley-Etzkorn, K. E. (2018). Learning to teach online: Measuring the influence of faculty development training on teaching effectiveness through a TPACK lens. *The Internet and Higher Education*, *38*, 28-35.

Chai, C. S., Jong, M., & Yan, Z. (2020). Surveying Chinese teachers' technological pedagogical STEM knowledge: A pilot validation of STEM-TPACK survey. International Journal of Mobile Learning and Organisation, 14(2), 203-214. Huang, K. Y., Chen, Y. H., & Jang, S. J. (2020). TPACK in special education schools for svi: a comparative study between taiwanese and chinese in-service teachers. International journal of disability, development and education, 1-16.

Comas-Quinn, A. (2011). Learning to teach online or learning to become an online teacher: An exploration of teachers' experiences in a blended learning course. ReCALL, 23(3), 218-232.

Dahlan, T., Darta, Pamungkas, T., Alamsyah, Wardhani, I.S. (2021) Covid-19 Pandemic: Online Learning Patforms for Elementary Schools. *Jurnal Pendidikan Sekolah Dasar.* 7(1), 33-44.

Dziuban, C., Graham, C. R., Moskal, P. D., Norberg, A., & Sicilia, N. (2018). Blended learning: the new normal and emerging technologies. *International journal of educational technology in Higher education*, *15*(1), 1-16.

Faturohman, N., Solihatulmilah, E. (2021) The Effectiveness of Distance Learning in Covid-19 Pandemic Era at Elementary School education Levels in Serang Regency. *Jurnal Pendidikan Sekolah Dasar.* 7(2) 252-263.

Gestiardi, R., Sarwanto, S., Chumdari, C., & Maryani, I. (2021). Using an Technology Readiness Model to

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Understand Perceived Usefulness of Learning in the Covid-19 Era. International Journal of Elementary Education, 5(4).

Graham, C. R. (2006). Blended learning systems. *The handbook of blended learning: Global perspectives, local designs*, *1*, 3-21.

Hockly, N. (2018). Blended learning. *Elt Journal*, *72*(1), 97-101.

Juanda, A., Shidiq, A. S., & Nasrudin, D. (2021). Teacher Learning Management: Investigating Biology Teachers' TPACK to Conduct Learning During the Covid-19 Outbreak. *Jurnal Pendidikan IPA Indonesia*, *10*(1), 48-59.

Hrastinski, S. (2019). What do we mean by blended learning?. *TechTrends*, *63*(5), 564-569.

Koehler, M., & Mishra, P. (2009). What is Technological Pedagogical Content Knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, 9(1)

Koh, J. H. L. (2019). TPACK design scaffolds for supporting teacher pedagogical change. *Educational Technology Research and Development*, 67(3), 577-595)

Megahed, N., & Hassan, A. (2021). A blended learning strategy: reimagining the post-Covid-19 architectural education. *Archnet-IJAR: International Journal of Architectural Research*.

Mujallid, A. (2021). Instructors Readiness to Teach Online: A Review of TPACK Standards in Online Professional Development Programmes in Higher Education. *International Journal of Learning,*

Teaching and Educational Research, 20(7).

Purnomo, P., & Palupi, M. S. (2016). Pengembangan Tes Hasil Belajar Matematika Materi Menyelesaikan Masalah Yang Berkaitan Dengan Waktu, Jarak Dan Kecepatan Untuk Siswa Kelas V. *Jurnal Penelitian (Edisi Khusus PGSD)*, *20*(2), 151–157.

Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. *Computers & Education*, *144*, 103701.

Rienties, B., Brouwer, N., Bohle Carbonell, K., Townsend, D., Rozendal, A. P., van der Loo, J., ... & Lygo-Baker, S. (2013). Online training of TPACK skills of higher education scholars: A cross-institutional impact study. *European Journal of Teacher Education*, *36*(4), 480-495.

Rochintaniawati, D., Riandi, R., Kestianty, J., Kindy, N., & Rukayadi, Y. (2019). The Analysis of Biology Teachers Technological Pedagogical Content Knowledge Development in Lesson Study in West Java Indonesia. *Jurnal Pendidikan IPA Indonesia*, *8*(2), 201-210.

Setiawan, B., Vina I. (2020) Covid-19 Pandemic: The Influence of Full-Online Learning for Elementary School in Rural Areas. *Jurnal Pendidikan Sekolah Dasar.* 6(2), 114-123

Sulisworo, D., Astuti, A. Y., & Fatimah, N. (2020). Online learning implementation during COVID-19

mitigation in Indonesia: Measuring the lecturers' technology readiness. *International Journal of Advanced Science and Technology*, 29(7), 2252-2263.

Tanak, A. (2020). Designing TPACK-based course for preparing student teachers to teach science with technological pedagogical content knowledge. Kasetsart Journal of Social Sciences, 41(1), 53-59.

Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2020). Enhancing pre-service teachers' technological pedagogical content knowledge (TPACK): A mixed-method study. Educational Technology Research and Development, 68(1), 319-343

Undang-Undang Negara Republik Indonesia Nomor 14 Tahun 2005 tentang Guru dan Dosen.

Wei Wang, Denise Schmidt-Crawford & Yi Jin (2018) Preservice Teachers' TPACK Development: A Review of Literature, *Journal of Digital Learning in Teacher Education*, 34:4, 234-258, DOI: 10.1080/21532974.2018.149803