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Technological Knowledge (TK) of Elementary School Teacher Education Program Students in Elementary Science Learning

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Abstrak
Guru merupakan salah satu komponen keberhasilan suatu pendidikan. *Technological Knowledge* (TK) atau pengetahuan teknologi yang merupakan salah saru kerangka dari *Technological Pedagogical Content Knowledge* (TPACK) adalah pengetahuan yang dimiliki oleh guru agar mampu mentransfer atau mengajarkan konten agar lebih mudah dipahami oleh siswa. Tujuan dari penelitian ini adalah untuk menanalisis TK mahasiswa calon guru sekolah dasar pada pembelajaran IPA SD. Penelitian ini menggunakan jenis penelitian deskriptif dengan pendekatan kuantitatif. Adapun populasi penelitian merupakan mahasiswa Pendidikan Guru Sekolah Dasar (PGSD) Universitas Kristen Indonesia Toraja Angkatan Tahun 2019. Sedangkan sampel penelitian merupakan mahasiswa yang telah memprogram mata kuliah Pengenalan Lapangan Persekolahan (PLP) II, Pengembangan Pembelajaran IPA dan Aplikasi Komputer sebanyak 72 responden. Instrumen yang digunakan merupakan instrumen yang dikembangkan dari penelitian Akyuz, Desstya dan Mishra yang merupakan instrumen yang telah diuji validitas dan reabilitasnya dan dirancang khusus untuk jenjang sekolah dasar. Pengolahan data dilakukan dengan bantuan aplikasi *Microsoft Excel* dimana data yang telah dikumpulkan kemudian dicari rata-rata skor per indikator dan kategorinya. Hasil penelitian menunjukkan bahwa total rata-rata TK calon guru sekolah dasar pada pembelajaran IPA SD sebesar 7,3. Dari hasil tersebut, dapat disimpulkan bahwa TK calon guru sekolah dasar pada pembelajaran IPA dikategorikan "Tinggi".

Kata Kunci: *Technological Knowledge*, Guru, Sekolah Dasar, Pembelajaran IPA

Abstract

Teaching is a component of the success of education. Technological knowledge (TK) or technological knowledge, which is one of the frameworks of technological pedagogical content knowledge (TPACK), is knowledge that students possess in order to be able to transmit or impart content to facilitate understanding for students. The aim of this study was to identify the kindergarten students of prospective primary school teachers in elementary science learning. This study uses a descriptive type of research with a quantitative approach. The research population are the students of the UKI Toraja Elementary School Teacher Education Class of 2019. While the research sample consists of students who have taken the courses Introduction to School Fields, Science Learning Development, and Computer Applications, there are no less than 72 respondents. The instrument used is an instrument developed from the research of Akyuz, Desstya, and Mishra, tested for validity and reliability and specially designed for the elementary school level. Data processing is done using the Microsoft Excel application, where the collected data is then searched for the average score per indicator and category. The results of the study showed that the average overall TK of the primary school teacher candidates in elementary science instruction was 7,3. From these results, it can be concluded that the kindergarten teacher candidates for primary school are classified as "high" in science lessons.

Keywords: *Tecnological Knowledge, Teachers, Elementary School, Science Learning*

Introduction

The success of an education is inseparable from the ability and effort of teachers to educate students, not least in elementary schools (Aryanto et al., 2021). Therefore, it is important for prospective teachers to develop their teaching and parenting skills during their studies, either through micro-lessons, seminars, or teacher skills training. This then makes the education and teacher training departments a beacon of hope for the initial quality of the teachers and the learning progress in the schools (Loughran & Hamilton, 2016). One of the important skills that the teacher possesses and develops is the knowledge of how to deal with learning situations so that the students can easily understand the learning content provided. This knowledge is called Pedagogical Content Knowledge (PCK) (J Loughran et al., 2012). This means that it is not enough for the teacher to simply have a command of the content or material, but rather that they must be able to

have knowledge of how to deliver the content (Haider & Jalal, 2018; Panggarra & Trivena, 2021). Indeed, experience in teaching the content of a material is one of the factors in increasing the teacher's PCK (Agustina, 2015).

Along with the development of science and technology in the 21st century and in recent years, the world has been hit by the COVID-19 pandemic, teachers need to be able to use digital technologies and online information systems to carry out the learning (Haider & Jalal, 2018). In addition, digital technology in education is also one of the educational issues discussed in the presidency of G20 countries, in the hope that technology can be a solution to problems of access, quality, and social equity in education. Teachers' technological knowledge is also expected to support teachers in broadcasting or conveying content to make it easier to understand for postmillennial students who are already familiar with the use of smartphones, tablets, and online information systems (Haider & Jalal, 2018).

The combination of pedagogical knowledge, content and technology is called Tecnological Pedagogical Content Knowledge (TPACK) (Koehler et al., 2013). When building a teacher's TPACK, it is better to start from scratch since you are still a prospective teacher or student. This should have become a teacher training program to prepare aspiring teachers to use technology effectively in teaching subject matter (Haider & Jalal, 2018). For example, by adding dedicated courses and support related to technology and online learning systems (Baran et al., 2019). Several previous studies have shown that teachers who have 10-15 years of teaching experience of their own still lack PCK and TPACK knowledge, especially when it comes to choosing the right strategy when teaching content and using technology, which are still minimal (Maryani & Martaningsih, 2015; Trivena & Hakpantria, 2020).

Over time, Mishra and Koehler introduced Technological Pedagogical Content Knowledge (TPACK) as a conceptual framework for teachers' knowledge development to effectively deliver content through the use of technology, which was announced in 2007 under the term Total PACKage (TPACK) (Koehler & Mishra, 2005; Thompson & Mishra, 2007). The TPACK knowledge domains are: (1) Techonological Knowledge (TK); (2) Pedagogical Knowledge (PK); (3) Content Knowledge dan kemudian diturunkan ke Tehcnological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK) and Technological Pedagogical Content Knowledge (TPACK) (Voogt et al., 2013). Here's the TPACK knowledge domain diagram below (Akyuz, 2018):

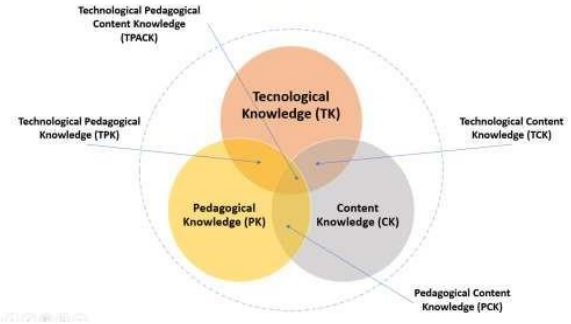

Figure 1. TPACK framework

Research on the TPACK of teachers and prospective primary school teachers has been conducted by several researchers. A study conducted by Akhwani in 2021 shows that TPACK is in the "good" category for teachers participating in Teacher Professional Education. (Akhwani & Rahayu, 2021). The results of the same study, also prepared by Rigianti, showed that the abilities of TCK and TPK had a significantly positive effect on the TPACK-21 of elementary school teachers in Sukabumi (Lukman, H. S., Sutisnawati, A., & Setiana, A., 2022). Similar to that of Fitriyana et al., we conducted a study that showed that the ability to teach prospective teachers using websites, software, and hardware was rated as very good. However, no research on the ability of prospective primary school teachers to understand technology that can be used in science learning was found in several studies related to TPACK for elementary school and prospective teachers (Fitriyana et al., 2021). However, from several studies related to TPACK for elementary school and prospective teachers, there was no research showing the ability of prospective primary school teachers to understand technology that can be used in science learning.

One of the TPACK components that a teacher or prospective teacher must have is Technological Knowledge (TK), or knowledge of technology. Kindergarten involves the teacher's knowledge of the use of computing devices and other technology-based devices that can be used in learning (Fitriyana et al., 2021). This is inseparable from the role of schools, which in preparing for a 'knowledge society' must of course take into account the integration of Information Technology and Computers (ICT) into curriculum development (Ghavifekr et al., 2012).

Science learning in primary school involves learning science content that is frequently perceived as difficult by both students and teachers. The lack of strategies or methods in science teaching suggests that most teachers are not yet familiar with PCK. This is consistent with the opinion of Van Driel and Amanda, who explained that PCK is a teacher's understanding of how to help students understand the content of the material being taught, one of which is through appropriate instructional strategies (van Driel & Berry, 2012). In addition, the application of ICT is considered effective in improving the quality of learning, including science learning in primary schools. With this in mind, researchers are interested in researching kindergarten students for prospective primary school teachers in science learning, hoping that it can be a precaution for students facing the technological advances of this century and that information for further research related to TPACK for school teachers can provide prospective elementary school children with science learning in elementary school.

Method

This study uses a descriptive type of research with a quantitative approach. According to Arikunto, descriptive research is a type of research that only aims to describe or describe a variable without attempting to prove a hypothesis, whereas research with a quantitative approach is research that employs a large number of numbers, from data acquisition to data interpretation to results presentation. (Arikunto, 2013). The research population consisted of Elementary School Teacher Education Program students in the Toraja Class of the Christian University of Indonesia from 2019. The research sample consisted of students taking Introduction to Schooling II, Development of Science Learning, and Computers, with as many as 72 respondents.

A questionnaire is used as an instrument, which is measured using a Likert scale: (1) strongly disagree; (2) disagree; (3) consent; and (4) fully agree and support the interview guide. The instrument used is a tool developed from research by Akyuz (2018), Desstya (2018) and Mishra (2019), which has been tested for validity and reliability and is specifically designed for the elementary school level. Data processing is done using the Microsoft Excel application, where the collected data is then searched for the average score per indicator. After that, the average score obtained is divided into the following intervals:

Table 1. Interval Categories

Interval	Kategori
8,5 - 10	Very High
6,9 - 8,4	High
5,3 - 6,8	Currently
3,7 - 5,2	Low
2 - 3,6	Very Low

Result and Discussion

Based on the processing of the questionnaire data, the average category of technological knowledge (TK) interval scores for elementary school teacher candidates in elementary science learning were determined as follows:

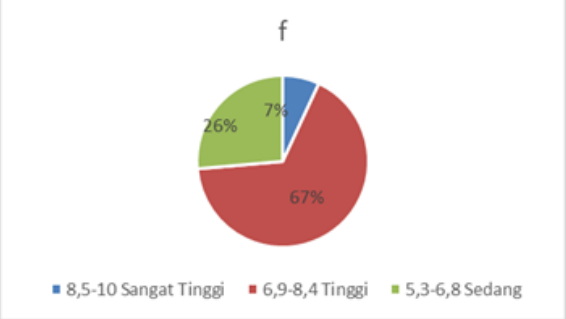

Figure 2. Kindergarten intervals for prospective primary school teachers in elementary science learning

From Figure 2 above, it shows that 67% of elementary school teacher candidates get an average kindergarten interval score of 6.9–8.4 in science learning in the high category, 26% get an average interval score of 5.3–6.8 in the medium category, and 7% get an average interval score of 8.5–10 in the very high category. Meanwhile, for each indicator used to measure the TK of prospective elementary school teacher students, the results of processing data on the average score and category of each indicator can be seen in the table below:

Table 2. Categories of Technological Knowledge (TK) of Prospective Elementary School Teachers in Elementary Science Learning

No.	Indicator	Avarage	Category
1.	Basic knowledge of Information and Communication Technology (ICT)	7.3	High
2.	Use of the projector (LCD)	7	High
3.	Internet access	7.5	High
4.	Use of non-ICT media	7.3	High
5.	Operation of online learning applications	7.2	High
Total Avarage		7.3	Tinggi

Based on Table 2, it is found that the average total TK of prospective elementary school teacher students in science learning is 7.3. From these data, it can be concluded that the science learning skills of the kindergarten students of prospective elementary school teachers are categorized as "high." The results of data processing on each indicator can be seen through the following data exposures:

Table 3. Basic Knowledge of Information Technology and Computers (ICT)

No.	Sub-Indicator	Avarage	Category
1.	It's easier to write than to type assignments in word	5.6	Currently
2.	Prefer to explain without making a power point when presenting in front of the class	6.9	High
3.	Able to operate Microsoft applications	8.1	High
4.	Able to operate laptop/PC	8	High
5.	Making material in power point when I teach in class	7.7	High
Total Avarage		7.3	High

Table 3 shows that the average TK values of the prospective primary school teacher trainees in the ICT basic knowledge indicators are classified as high overall. Each sub-indicator also has the "high" category, except for the first sub-indicator, where a medium category means that, on average, there are students who are used to writing in books and typing problems into words. Based on these results, it can be concluded that prospective primary school teachers' students already have a good knowledge of basic ICT skills and have used ICT in their learning. These results are supported by data showing that the age of the respondents, aged 20–21, corresponds to the millennial generation, who have acquired basic ICT skills since high school, so they have no difficulty using computers or basic applications like Word and PowerPoint (Astini, 2019). Of course, this is a good starting point for prospective primary school teachers, as the teacher will later be the key holder in implementing ICT in the classroom to prepare

students for today's digital age (Edvard Hatlevik & Christian Arnseth, 2012).

Table 4. Use of the projector (LCD)

No.	Sub-Indicator	Avarage	Category
1.	Using the LCD to display the results of presentations in lectures	8.3	High
2.	Using LCD when teaching at school	6.6	High
3.	Prefer to teach by lecture method	5	Low
4.	It's easier to explain using the LCD	8	High
	Total Avarage	7	High

Based on Table 4, the research results showed that, on the indicator of using or operating a projector or liquid crystal display (LCD), prospective elementary school teacher students obtained a score of 7, or were categorized as high. This is supported by the results of sub-indicator 3, where the use of the lecture method when teaching in schools is categorized as low. This means that both when presenting the results of presentations in class and teaching at school, students are more comfortable using the LCD to make it easier to explain. These results indicate that in implementing technology-based learning in the classroom, students have taken a good step in realizing that the use of LCDs is an important technology for facilitating the presentation of subject matter and increasing student learning motivation through attractive presentations on LCDs (Hariadi, 2017).

Table 5. Internet Acces

No.	Sub-Indicator	Avarage	Category
1.	Search for assignments or materials via Google or Wikipedia	8.1	High
2.	Adequate internet access at home	6.8	High
3.	Accessing materials to be taught in class using the internet	7.7	High
	Total Avarage	7.5	High

Table 5 above shows that Internet access is rated highly by primary school teacher candidates, with an average score of 7.5. This shows that students have no difficulty accessing the Internet both for lecture purposes and when looking for teaching materials for lessons at school. Internet access is one of the most important things to support the current learning process, especially during the COVID-19 pandemic (Allo, 2020).

Table 6. Use non-ICT Media

No.	Sub-Indicator	Avarage	Category
1.	Using science teaching aids when teaching in class	8.1	High
2.	Explaining science material in books directly to students without any media	6	High
3.	Able to use the IPA KIT provided at school	7.3	High
4.	Make your own science teaching aids from nearby materials	7.6	High
	Total Avarage	7.3	High

Based on the indicators presented in Table 6, the results show that the use of non-ICT media by students is in the "high" category, with an average score of 7.3. Non-ICT media are learning media or simple visual aids that are used by teachers in classroom learning that are not yet based on information and

computer technology (ICT). The use of visual aids in science learning is very important because teaching natural science material or concepts requires apprenticeships, which of course require teaching aids such as electricity, simple machines, energy, and other natural science materials (Lewis, 2019). Prospective elementary school teachers not only need to understand how to use ICT but also understand how to use non-ICT learning media.non TIK.

Tabel 7. Operation of Online Learning Applications

No.	Sub-Indicator	Avarage	Category
1.	Using virtual learning such as google meet or zoom while teaching at school	5.9	Currently
2.	Using youtube to access learning materials in class	7.4	High
3.	Using WhatsApp while teaching at school	8.2	High
Total Avarage		7.3	High

The results of the data processing for the last indicator in Table 7 show that the knowledge of the students in using learning applications such as Google Meet, Zoom, Whatsapp, and YouTube can be classified as high with a grade of 7.3. In the third sub-indicator, however, it can be seen that students use WhatsApp more frequently in school lessons. This is because, during the COVID-19 pandemic, primary school teachers mainly used WhatsApp groups to communicate and send materials and assignments when students learned from home, as they were seen as the most easily accessible for students and parents who helped children learn from home (Zulkanain et al., 2020).

Conclusion

Technological Knowledge (TK) mahasiswa calon guru sekolah dasar pada pembelajaran IPA SD terdiri dari kategori Tinggi dengan rata-rata skor 7.3. This indicates that student learning will be based on technology such as TIK knowledge, the use of LCD displays, access to the internet, non-TIK media, and the use of online learning applications. However, it is necessary to increase the amount of knowledge and technology available to teachers so that it can be used to transfer material or concepts in a timely manner so that students can understand them.

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