vailable at http://ejournal.stkipjb.ac.id/index.php/jeel
P-ISSN 2356-5446
E-ISSN 2598-3059

PRE-SERVICE TEACHERS' SELF-EVALUATION ON THEIR TECHNOLOGICAL PEDAGOGICAL AND CONTENT KNOWLEDGE (TPACK)

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Abstract

Technological advances in the 21st century have had a major influence on the development of education today. The integration of technology into the classroom affects the learning process as well as the way teachers implement and develop learning activities in the classroom. The ability of teachers to master technology in learning can be viewed through their Technological Pedagogical and Content Knowledge (TPACK). This study aimed to find out about the pre-service teachers' self-assessment English teachers of their TPACK. This study used a quantitative design to determine pre-service teachers' self-assessment of the TPACK framework. A survey was conducted to view and collect data using self-assessment questionnaires on TPACK. The participants were given the questionnaire, which contained four Likert scale scales to gain the data. The subjects of this research were 47 participants pre-service teachers in English Language Education at STKIP PGRI Jombang. The conclusion of this study is that the overall TPACK of pre-service has an average value of 2,96 with the high category.

Keyword: *Pre-service teachers, Self-Assessment, TPACK, 21st century learning*

Abstrak

Kemajuan teknologi pada abad ke-21 telah memberikan pengaruh besar terhadap perkembangan pendidikan saat ini. Integrasi teknologi ke dalam kelas mempengaruhi proses pembelajaran serta cara guru melaksanakan dan mengembangkan kegiatan pembelajaran di kelas. Kemapuan guru dalam menguasai teknologi dalam pembelajaran dapat dilihat dari Technological Pedagogical and Content Knowledge (TPACK) mereka. Penelitian ini bertujuan untuk mengetahui persepsi calon guru Bahasa Inggris terhadap TPACK mereka. Penelitian ini menggunakan desain kuantitatif untuk mengetahui pengukuran diri

guru prajabatan terhadap kerangka TPACK. Survei dilakukan untuk melihat dan mengumpulkan data dengan menggunakan kuesioner, para peserta diberikan kuesioner yang berisi empat skala Likert untuk mendapatkan data. Subjek penelitian ini adalah 47 peserta calon guru Pendidikan Bahasa Inggris di STKIP PGRI Jombang. Kesimpulan dari penelitian ini adalah kemampuan TPACK siswa secara keseluruhan memiliki nilai rata-rata sebesar 2,96 dengan kategori tinggi.

Kata kunci: *Pengukuran diri, Calon guru, TPACK, pembelajaran abad ke-21*

Introduction

One of the most prominent characteristics of education in the 21st century is the increasingly interconnected world of knowledge, so the synergy between them is growing rapidly. The accelerated increase in knowledge is supported by the application of digital media and technology which is growing rapidly (Muliastrini, 2020). Education in the 21st century is education that integrates knowledge, skills, behavior, and students' mastery of ICT (Faisal, 2019). The skills possessed by these students can be developed through the application of learning models based on student activities that follow the characteristics of learning competencies and learning materials. 21st-century learning requires teachers to have teaching skills that are always creative and innovative (Tarihoran, 2019).

One of the learning innovations that is overgrowing is technology-based learning. This is based on technological developments which are growing day by day. Moreover, in the Merdeka Curriculum 2022, teachers are required to be able to master content and pedagogy and are also expected to apply technology in learning. Improving teacher quality is not only in terms of teacher welfare but can also be achieved by increasing teacher professionalism and teaching abilities (Turmuzi & Kurniawan, 2021). The professional and pedagogical abilities of teachers are basically crucial for teachers. According to Koehler & Mishra 2014, teaching is a complex activity that involves many kinds of knowledge. Learning activities are based on knowledge of the material to be studied taught (content knowledge), how to teach a material (pedagogical knowledge), and knowledge about the use of various technologies (technological knowledge) have intersections or intersections to be able to support one another. Sintawati & Indriani (2019) state that the ability of teachers to master technology in learning

can be viewed through their Technological Pedagogical and Content Knowledge (TPACK).

TPACK (Technological Pedagogical and Content Knowledge) was coined by Shulman (1987) about PCK (Pedagogical Content Knowledge), which explains educational technology and PCK interaction with one another to create effective learning with the use of technology. Then the TPACK concept was developed by Koehler et al. (2008) because of the rapid technological developments in society. Koehler et al. (2008) state that the TPACK principle is a combination of technology, pedagogy, and content/material applied in one context. The TPACK framework developed by Mishra & Koehler contains seven TPACK categories. The TPACK component explained by Koehler et al. (2008) that TPACK is emergent from the knowledge that goes beyond all three core components (Content, Pedagogy, and Technology), technological pedagogical content knowledge is an understanding that emerges from interactions among content, pedagogy, and technology knowledge. Suyamto et al. (2020) state TPACK is a framework that tries to understand the relationship between knowledge about teaching (pedagogical knowledge) and the use of technology (technology knowledge).

TPACK is increasingly becoming an important framework adopted by many researchers and educators to enhance teacher pre-service knowledge in integrating digital technology into teaching and learning in the classroom (Irwanto et al. 2022). Pre-service teachers are demanded upon graduation to be ready to teach in a way that matches the current need, which means they must have sufficient TPACK to achieve it. One way for pre-service teachers to prepare for this is by taking PLP *(Pengenalan Lingkungan Persekolahan)* program in which the students do a real teaching practice in a real school situation. As education students, pre-service English teachers are assigned to carry out a PLP program that requires direct contact with students in senior high schools. The PLP program enables pre-service teachers to gain practical experience in the teaching process with guided and supervised instruction. In the PLP STKIP PGRI Jombang 2022 program, pre-service teachers are faced with the 2022 Merdeka curriculum. Where pre-service teachers are required to be able to master content and pedagogy and are also expected to be able to apply technology in learning. Pre-service teachers of STKIP PGRI Jombang 2019 have been prepared for direct contact with students in high schools, so they already have TPACK.

Based on the conditions, the researcher was interested in surveying self-assessment pre-service on their TPACK. Efforts to improve and develop TPACK pre-

service teachers require the development and improvement of knowledge of pre-service teachers will be in the complex relationship between pedagogic, content and technology because this understanding can be used to develop strategies, approaches, media, methods, and teaching techniques according to the Merdeka Curriculum 2022.

Several studies related to self-assessment pre-service teachers about TPACK that have been conducted by previous researchers have shown many similar results. An example of studies is written by Septiyanti et al. (2020). They investigated the TPACK perception of English Education students at Lampung University, the way the students obtain TPACK in learning, and the role of lecturers in assisting the students in obtaining TPACK in learning. The data were gained by mixed methods using questionnaires and interviews. The result stated the TPACK perception of the students was generally good as the score of all domains measured (Technological Knowledge/TK, Technological Content Knowledge/TCK, Technological Pedagogical Knowledge/TPK, Technological Pedagogical Content Knowledge/TPCK, and Technology-related Learning Experiences/TLE) categorized as high. Then in the studies written by Wijaya et al. (2022) the research focused on finding out the perception of student-teachers towards TPACK. The study uses quantitative design to determine student-teacher perceptions of the TPACK framework using a quantitative design questionnaire, and the result showed student-teachers have a positive perception regarding the implementation of TPACK in the teaching process. The two previous studies had the same objective, namely, to find out the perceptions of English students at their university and both studies showed positive perception results, which differed only in the research method. Septiyani used a mixed method research method using questionnaires and interviews, while Wijaya's research used a quantitative design questionnaire.

The next research on the self-assessment pre-service teacher of TPACK was also carried out by Irwanto et al. (2022). This study aims to examine pre-service teachers' perceptions of TPACK in relation to their age, gender, and grade level. The survey design was used in this quantitative non-experimental research, and independent t-test, ANOVA, and Person correlation were executed to analyze the data. The findings suggested that pre-service teachers performed at the highest self-confidence level in pedagogy knowledge and the lowest in technology knowledge. They rated themselves above four on a five-point scale. No significant differences for all TPACK dimensions were found in terms of gender and age. In addition, there was a significant difference between pre-service teachers who

were at the postgraduate level and those at the undergraduate level. Moreover, a highly positive and significant correlation existed between all six TPACK domains.

Based on the explanation of the background, in investigating the self-assessment of pre-service teacher on their TPACK, many researchers use various methods in their papers. And in previous studies, it was shown that the object of the research was English students who were not pre-service teachers who had taken PLP courses and previous research had focused on perception. Based on this, the researcher wants to examine more deeply the self-assessment of pre-service teachers at STKIP PGRI Jombang 2019 English Language Education regarding their Technological Pedagogical and Content Knowledge (TPACK).

Research Methods

The approach of this study used quantitative method based on the aims and the needs of the research. Quantitative research was an approach for testing objective theories by examining the relationship among variables (Cresswell, 2014). The aims of this study to determine pre-service teachers' self-assessment of their TPACK.

The design of this study is classified as a survey design. A survey design provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population (Cresswell, 2014). The purpose of this survey was to explain the characteristics of a population. To find out the pre-service teachers' self-assessment on their TPACK, researchers used a survey design to describe and interpret what it is.

In this study, the researchers collected data by using a questionnaire where the contents were adopted from (Chai et al., 2013). The reason researcher adopted content questioners from Chai et al (2013) because The CFA (Confirmatory Factor Analysis) indicates that the survey instrument is valid and reliable for measuring all seven knowledge factors of the preservice teachers' TPACK and this instrument is suitable with the variables that researcher will examine. The content of questionnaire is 31 questions that following some section, those are: Content Knowledge (CK) 4 questions, Pedagogical Content Knowledge (PCK) 5 questions, Pedagogical Knowledge (PK) 5 questions, Technological Pedagogical and Content Knowledge (TPACK) 5 questions, Technological Content Knowledge (TCK) 4 questions, Technological Pedagogical Knowledge (TPK) 4 questions, Technological Knowledge (TK) 4 questions. The

answer for each item uses a Likert scale. Rukminingsih (2020) states that Likert scale is used to measure an attitude, opinion, and perception of a person or group about social phenomenon. The researcher used a 4-point Likert scale for each statement to determine whether they agree, strongly agree, disagree, and strongly disagree with the statement. Respondents answered questions using the 4-point scale.

According to Widoyoko in (Purnomo & Palupi, 2016), the questionnaire in this study was used to group students based on Technological Pedagogical and Content Knowledge (TPACK) criteria into four groups namely very good, good, medium, and low as shown in **Table 1.**

Table 1. TPACK Category Level (Adapted from Widoyoko, 2016)

Variable	Category	Interval
TPACK	Very good	3,26 < x ≤ 4,00
	Good	2,51 < x ≤ 3,25
	Medium	1,76 < x ≤ 2,50
	Low	0,00 < x ≤ 1,75

Results and Discussion

The descriptive data presented includes the mean. This means that it is the calculated average. The results of the respondents' questionnaire answers are presented in **Table 2.**

Table 2. The Results of The Respondents' Questionnaire Answers

No	Item	Mean
1	Content Knowledge (CK)	2,98
2	Pedagogical Content Knowledge (PCK)	2,71
3	Pedagogical Knowledge (PK)	3,02
4	Technological Pedagogical and Content Knowledge (TPACK)	2,92
5	Technological Content Knowledge (TCK)	3,02
6	Technological Pedagogical Knowledge (TPK)	3,02
7	Technological Knowledge (TK)	3,11

Pre-Service Teachers self-assessment on their Technological Pedagogical and Content Knowledge (TPACK) include 7 components: Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Pedagogical Knowledge (PK), Technological Pedagogical and Content Knowledge (TPACK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Knowledge (TK). Based in the **table 2** the TPACK the pre-service is good with average mean score of Content Knowledge (CK) 2,98; Pedagogical Content Knowledge (PCK) 2,71; Pedagogical Knowledge (PK) 3,02; Technological Pedagogical and Content Knowledge (TPACK) 2,92; Technological Content Knowledge (TCK) 3,02; Technological Pedagogical Knowledge (TPK) 3,02; and Technological Knowledge (TK) 3,11.

Content Knowledge (CK)

Content Knowledge is the first component that includes 4 statements. The researcher finds out the result of Content Knowledge component of pre-service teacher' self-assessment response in the questionnaire in **Table 3.**

Table 3. Score Pre-Service teachers' self-assessment for Content Knowledge (CK)

No. Item	Items	Mean
1	I have sufficient knowledge about my teaching subject.	2,98
2	I can think about the content of my teaching subject like a subject matter expert.	2,89
3	I am able to gain deeper understanding about the content of my teaching subject on my own	3,04
4	I am confident to teach the subject matter.	3,02
	Average Mean	**2,98**

Based on **Table 3**, the researcher finds out the most average mean pre-service CK is in the good category (2,98). The highest mean is a statement about understanding the content of learning material with mean of 3,04 and statement about confident to teach the subject matter with the mean 3,02. The lowest mean is in the statement pre-service can think about the content of their teaching

subject like a subject matter expert with mean 2,89. This shows that pre-service English teachers at STKIP PGRI Jombang 2019 have sufficient knowledge of English theory for the material to be taught and they have good confident to teach but they are still lacking in terms of material knowledge and in mastering the material they will teach.

Pedagogical Content Knowledge (PCK)

Pedagogical Content Knowledge is the second indicator that includes 5 statements. The researcher finds out the result of Pedagogical Content Knowledge indicator of pre-service teacher' self-assessment response in the questionnaire in **Table 4.**

Table 4. Score Pre-Service teachers' self-assessment for Pedagogical Content Knowledge (PCK)

No. Item	Items	Mean
5	Without using technology, I can help my students to understand the content knowledge of my teaching subject through various ways.	2,66
6	Without using technology, I can address the common learning difficulties my students have for my teaching subject.	2,62
7	Without using technology, I can facilitate meaningful discussion about the content students are learning in my teaching subject.	2,70
8	Without using technology, I can engage students in solving real world problem related to my teaching subject.	2,74
9	Without using technology, I can support students to manage their learning of content for my teaching subject	2,83
	Average Mean	2,71

Based on **Table 4**, the researcher finds out that the average mean pre-service PCK score is in the good category (2,71). The highest mean is a statement about pre-service support students to manage their learning of content for their teaching subject without technology with mean 2,83 and pre-service can engage students in solving real world problem related to their teaching subject without

technology with mean 2,74. The lowest mean is in the statement pre-service can address the common learning difficulties their students have for their teaching subject without technology with mean 2,62. This shows that pre-service teachers can understand how to display and present material so that the material will be taught in class in various ways. This also proves that with a high PCK category, the pre-service English teacher at STKIP PGRI Jombang 2019 has been able to be placed in various conditions such as (schools lacking technological facilities).

Pedagogical Knowledge (PK)

Pedagogical Knowledge is the third indicator that includes 5 statements. The researcher finds out the result of Pedagogic Knowledge indicator of self-assessment pre-service teacher response in the questionnaire in **Table 5.**

Table 5. Score Pre-Service teachers' Self-Assessment for Pedagogical Knowledge (PK)

No. Item	Items	Mean
10	I am able to stretch my students' thinking by creating challenging tasks for them.	3,00
11	I am able to guide my students to adopt appropriate learning strategies.	3,02
12	I am able to help my students to monitor their own learning.	2,98
13	I am able to help my students to reflect on their learning strategies	3,00
14	I am able to guide my students to discuss effectively during group work	3,13
	Average Mean	3,02

Based on **Table 5**, the researcher finds out that the average mean pre-service PK score is in the good category (3,02). The highest mean is the statement pre-service able to guide my students to discuss effectively during group work with mean 3,13 and the lowest mean is in the statement pre-service can be able to help the students to monitor their own learning with mean 2,98. The results obtained show that pre-service English teachers have good pedagogical knowledge. Pre-service is enough to master basic knowledge in the field of education, such as the

development of lesson plans, class management, evaluation Lessons, models, methods, and learning strategies.

Technological Pedagogical and Content Knowledge (TPACK)

Technological Pedagogical and Content Knowledge (TPACK) is the fourth indicator that includes 5 statements. The researcher finds out the result of Technological Pedagogical and Content Knowledge indicator of pre-service teacher' self-assessment response in the questionnaire in **Table 6.**

Table 6. Score Pre-Service Teachers' Self-Assessment for Technological Pedagogical and Content Knowledge (TPACK)

No. Item	Items	Mean
15	I can formulate in-depth discussion topics about the content knowledge and facilitate students' online collaboration with appropriate tools. (e.g., Google Sites, Discussion Forums)	3,04
16	I can structure activities to help students to construct different representations of the content knowledge using appropriate ICT tools (e.g., Webspiration, Mindmaps, Wikis).	2,85
17	I can create self-directed learning activities of the content knowledge with appropriate ICT tools (e.g., Blogs, Webquests).	2,87
18	I can design inquiry activities to guide students to make sense of the content knowledge with appropriate ICT tools (e.g., simulations, web-based materials)	2,85
19	I can design lessons that appropriately integrate content, technology and pedagogy for student-centred learning	3,00
	Average Mean	2,92

Based on **Table 6**, the researcher finds out that the most average mean pre-service TPACK score is in the good category (2,92). The highest mean is the statement pre-service is in the pre-service can formulate in-depth discussion topics about the content knowledge and facilitate students' online collaboration with appropriate tools with mean 3,04. The lowest mean in the statement pre-service can structure activities to help students to construct different representations of the content knowledge using appropriate ICT tools and pre-service can design inquiry activities to guide students to make sense of the content

knowledge with appropriate ICT tools with same mean 2,85. This shows that pre-service English teachers at STKIP PGRI Jombang can integrate technology, content, and pedagogy into the learning process.

Technological Content Knowledge (TCK)

Technological Content Knowledge (TCK) is the fifth indicator including 4 statements. The researcher finds out the result of Technological Content Knowledge indicator of pre-service teachers' self-assessment response in the questionnaire in **Table 7.**

Table 7. Score Pre-Service Teachers' Self-Assessment for Technological Content Knowledge (TCK)

No. Item	Items	Mean
20	I can use the software that are created specifically for my teaching subject. (e.g., e-dictionary/corpus for language; Geometric sketchpad for Maths; Data loggers for science)	2,87
21	I know about the technologies that I have to use for the research of content of my teaching subject	3,11
22	I can use appropriate technologies (e.g., multimedia resources, simulation) to represent the content of my teaching subject	3,09
23	I can use specialized software to perform inquiry about my teaching subject	3,04
	Average Mean	3,02

Based on Table 7, the researcher finds out that the average mean pre-service TCK score is in the good category (3,02). The highest mean is the statement pre-service know about the technologies that they must use for the research of content of my teaching subject with mean 3,11. The lowest mean is in the statement pre-service can use the software that are created specifically for their teaching subject with mean 2,87. This shows that pre-service English teachers at STKIP PGRI Jombang can use technology to convey material.

Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge (TPK) is the sixth indicator that includes 4 statements. The researcher finds out the result of Technological Pedagogical Knowledge indicator of pre-service teachers' self-assessment response in the questionnaire in **Table 8.**

Table 8. Score Pre-Service teachers' Self-Assessment for Technological Pedagogical Knowledge (TPK)

No. Item	Items	Mean
24	I am able to use technology to introduce my students to real world scenarios	3,09
25	I am able to facilitate my students to use technology to plan and monitor their own learning.	2,96
26	I am able to facilitate my students to use technology to construct different forms of knowledge representation.	3,00
27	I am able to facilitate my students to collaborate with each other using technology	3,04
	Average Mean	3,02

Based on Table 8, the researcher finds out that the average mean pre-service TPK score is in the good category (3,02). The lowest mean is in the statement that students can facilitate students using technology to plan or monitor learning with mean 2,96 and the highest score is in the statement that pre-service can be able to use technology to introduce the students to real world scenarios with mean 3,09. This shows that the pre-service can select and use technology appropriate in the learning process to achieve learning objectives.

Technological Knowledge (TK)

Technological Knowledge is knowledge the seventh indicator that includes 4 statements. The researcher finds out the result of Technological Knowledge indicator of pre-service teachers' self-assessment response in the questionnaire in **Table 9.**

Table 9. Score Pre-Service teachers' Self-Assessment for Technological Knowledge (TK)

No. Item	Items	Mean
28	I have the technical skills to use computers effectively	3,09
29	I can learn technology easily	3,21
30	I know how to solve my own technical problems when using technology	3,02
31	I keep up with important new technologies.	3,15
	Average Mean	3,11

Based on Table 9, the researcher finds out that the average mean pre-service TK score is in the good category (3,11). The highest mean is in the statement pre-service can learn technology easily with mean of 3,21. The lowest mean is in the statement pre-service know how to solve their own technical problems when using technology with mean 3,02. This matter shows that pre-service can keep up with developments technology well and can utilize technology in the field of education.

The findings of this study have similarities with previous study conducted by Septiyanti (2020). The study by Septiyanti (2020), the TPACK perception of the students was generally good. But this study just focuses on analyzing 4 components of TPACK (TK, TCK, TPK, TPACK). While in this study researcher used 7 components of TPACK.

Similarities were also found in the findings of the study by Irwanto (2022). The findings indicate that all TPACK components of pre-service teachers were in the good category. Moreover, resemblance was also found in the findings of the study by Wijaya (2022). The result shows that pre-service have a good category in implementing all components TPACK in teaching English which has a good impact in conveying information from teachers to students in class by applying the TPACK model. Help from technology in teaching English to students has a positive influence on students' continuity and learning environment. In implementing TPACK in learning activities, pre-service English teachers can develop the learning process so that it takes place even with limitations (technology or each other). The results in this study show that pre-service English teachers at STKIP PGRI Jombang 2019 have good category in 7 components of TPACK. This shows that pre-service has been able to integrate technology, content, and pedagogy in the learning

process. As Mishra and Koehler (2009) stated that TPACK emphasize relationships between technology, content, and approach pedagogy to show how the teacher's understanding of technology, content, and pedagogy can interact with one another to produce discipline-based and efficient teaching.

Conclusion

Based on the results of the analysis of the self-assessment pre-service English teachers at STKIP PGRI Jombang 2019 about their TPACK, it can be concluded that the overall TPACK of the pre-service is good with average mean score 2,98. To be specific the average score of each component are Content Knowledge (CK) 2,98; Pedagogical Content Knowledge (PCK) 2,71; Pedagogical Knowledge (PK) 3,02; Technological Pedagogical and Content Knowledge (TPACK) 2,92; Technological Content Knowledge (TCK) 3,02; Technological Pedagogical Knowledge (TPK) 3,02; and Technological Knowledge (TK) 3,11. This answers the research question that most of the pre-service English teachers at STKIP PGRI Jombang 2019 have good category of several TPACK , namely the PK (3,02); TCK (3,02); TPK (3,02); and TK (3,11).

References

Ary, D. (2010). *Introduction To Research in Education 8th Edition*. Cengage Learning, Nelson Education.

Asdar, A. (2017). Students' self–assessment on their spoken interaction using CEFR. *Proc. Educ. Lang. Int. Conf.* 1, 148–161.

Borg, S., and Edmett, A. (2019). Developing a self-assessment tool for English language teachers. *Lang. Teach. Res.* 23, 655–679. doi: 10.1177/1362168817752543

Chai, C. S., Ng, E. M. W., Li, W., Hong, H.-Y., & Koh, J. H. L. (2013). Validating and modelling technological pedagogical content knowledge framework among Asian preservice teachers. In *Australasian Journal of Educational Technology* (Issue 1).

Cresswell, J. (2014). *Research Design: Qualitative, Quantitativ5e, Quantitative and Mixed Methods Approaches: Fourth Edition*. Sage Publications.

Faisal, M. (2019). Urgency Of The 21st Century Skills and Social Capital In Social Studies Mutiani. In *The Innovation of Social Studies Journal* (Vol. 1, Issue 1). https://ppjp.ulm.ac.id/journals/index.php/iis

Fuada, Z., & Soepriyanto, Y. (2020). Analisis Kemampuan Technological Content Knowledge (Tck) Pada Mahasiswa Program Studi Pendidikan Guru Sekolah Dasar. *JKTP Jurnal Kajian Teknologi Pendidikan*, *3*(3), 251–261. https://doi.org/10.17977/um038v3i32020p251

Goral, D. P., and Bailey, A. L. (2019). Student self-assessment of oral explanations: use of language learning progressions. *Lang. Test.* 36, 391–417. doi: 10.1177/0265532219826330

Harris, J., Mishra, P., & & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education*, *41*(4), 393–416.

Irwanto, I., Redhana, I. W., & Wahono, B. (2022). Examining Perceptions of Technological Pedagogical Content Knowledge (Tpack): A Perspective from Indonesian Pre-Service Teachers. *Jurnal Pendidikan IPA Indonesia*, *11*(1), 142–154. https://doi.org/10.15294/jpii.v11i1.32366

Khoerunisa, R. (2022). *Analisis Kemampuan Technological Pedagogical Content Knowledge (Tpack) Dalam Pembelajaran Daring Pada Calon Guru Kimia*.

Koehler, M. J., & Brant Ley-Dias, L. (2008). *Introducing Technological Pedagogical Content Knowledge*.

Koehler, M. J., & Mishra, P. (2009). What is Technological Pedagogical Content Knowledge? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70.

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers & Education*, *49*(3), 740–762.

Koehler, M. J., Shin, T. S., & Mishra, P. (2012). How do we measure TPACK? Let me count the ways. *In Educational Technology, Teacher Knowledge, and Classroom Impact: A Research Handbook on Frameworks and Approaches*, 16–31.

Listiawan, T. (2017). Representasi Mental Dan Proses Kognitif yang Mendasari Technological Pedagogical and Content Knowledge (TPACK). *Seminar Nasional Pendidik Dan Pengembang Pendidikan Indonesia*, 588–596.

Margerum-Leys, J., & Marx, R. W. (2002). Teacher knowledge of educational technology: A case study of student/mentor teacher pairs. *Journal of Educational Computing Research*, *26*(4), 427–462.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054.

Muliastrini, N. K. E. (2020). *New Literacy Sebagai Upaya Peningkatan Mutu Pendidikan Sekolah Dasar Di Abad 21*. *4*(1).

Pierce, L. V. (1999). Preparing independent learners: The role of self-assessment. *Revista Canaria de Estudios Ingleses* 38, 127–137.

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

Rukminingsih, A. W. (2020). *Metode Praktis Penelitian Pendidikan*. Erhaka Utama.

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK) the development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, *42*(2), 123–149.

Septiyanti, M., Inderawati, R., & Vianty, M. (2020). Technological Pedagogical and Content Knowledge (Tpack) Perception of English Education Students. *English Review: Journal of English Education*, *8*(2), 1. https://doi.org/10.25134/erjee.v8i2.2114

Shulman, L. S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, *15*, 4–14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the New Reform. *Harvard Educational Review*, *57*(1), 1–22.

Sintawati, M., & Indriani, F. (2019). *Pentingnya Technological Pedagogical Content Knowledge (Tpack) Guru Di Era Revolusi Industri 4.0*.

Slameto. (2003). *Belajar dan Faktor-Faktor yang Mempengaruhinya*. Rineka Cipta.

Sobur, A. (2009). *Psikologi Umum*. Pustaka Setia.

Sugiarto, Y. (2007). Pengaruh kredibilitas perusahaan dan kredibilitas endorser pada sikap dan niat membeli konsumen. *Doctoral Dissertation, UAJY*.

Sugiyono. (2016). *Metode Penelitian Pendekatan Kualitatif, Kuantitatif, R&D*. Alfabeta.

Suyamto, J., Masykuri, M., & Sarwanto, S. (2020). Analisis Kemampuan Tpack (Technolgical, Pedagogical, And Content, Knowledge) Guru Biologi Sma Dalam

Menyusun Perangkat Pembelajaran Materi Sistem Peredaran Darah. *INKUIRI: Jurnal Pendidikan IPA*, *9*(1), 46. https://doi.org/10.20961/inkuiri.v9i1.41381

Sweeder, J., & Bednar, M. R. (2001). "Flying" with educational technology. *Contemporary Issues in Technology and Teacher Education [Online Serial]*, *1*(3), 421–428.

Tarihoran, E. (2019). *GURU DALAM PENGAJARAN ABAD 21*.

Turmuzi, M., & Kurniawan, E. (2021). *Kemampuan Mengajar Mahasiswa Calon Guru Matematika Ditinjau dari Technological Pedagogical and Content Knowledge (TPACK) pada Mata Kuliah Micro Teaching*. *05*(03), 2484–2498.

Wijaya, I. N. A., Ratminingsih, N. M., & Dewi, N. L. P. E. S. (2022). English Language Education Student-Teachers' Perception on TPACK. *The Art of Teaching English as a Foreign Language*, *3*(1), 9–18. https://doi.org/10.36663/tatefl.v3i1.193