International Journal of Social Science Research and Review

http://ijssrr.com
editor@ijssrr.com
Volume 5, Issue 1
January, 2022
Pages: 166-175

Teacher Competency Analysis in Applying Technological, Pedagogical and Content Knowledge (TPACK) on Productive Learning in Vocational High School (VHS)

Hasanah; Muhammad Ardi; Lu`mu; Muhammad Nasir Malik

Makassar State University, Indonesia

Email: hasanah@unm.ac.id

http://dx.doi.org/10.47814/ijssrr.v5i1.162

Abstract

The aims of this study were to determine: (1) the competence of vocational high school (SMK) teachers in applying Technological, Pedagogical and Content Knowledge (TPACK) to productive learning in Makassar City; (2) The effect of TPACK knowledge, motivation and commitment of SMK teachers in implementing TPACK, attitudes towards TPACK, and the social conditions of teachers together on teacher competence in applying TPACK. This type of research is correlational research. The research location is a Vocational High School (SMK) in Makassar City. The sample size is 180 productive teachers, selected by the Cluster Random Sampling method. The dependent variable in this study is the competence of SMK teachers to apply TPACK in learning (Y). The independent variables are: Knowledge about TPACK (X1), motivation to apply TPACK (X2), attitude towards TPACK (X3), teacher commitment to implementing TPACK (X4), and the teacher's social environment (X5). The data analysis technique used is descriptive statistical analysis and infrensial statistical analysis. The analysis model is multiple regression. The results of the research are: (1) The competence of SMK teachers in applying TPACK in learning and knowledge of TPACK is in the medium category; attitudes, motivation, and commitment to implementing TPACK are in the low category; and the teacher's social environment is in the high category. (2) TPACK knowledge, attitudes, motivation, commitment, and the teacher's social environment influence together and make a real contribution to the competence of SMK teachers to apply TPACK in learning.

Keywords: *Competence; Productive Teachers; TPACK; Attitude; Motivation*

Introduction

The development of increasingly modern information and communication technology is one of the characteristics of technological developments in the 21st century. This technological development has an impact on a paradigm shift in education which focuses on the development and mastery of technological aspects in learning. Professional teachers are teachers who can compete and take advantage of opportunities in the modern era like today. According to Rahmadi (2019) that 21st century teachers

must have knowledge as well as skills in using various technological devices to facilitate learning and improve learning outcomes.

Teachers are one of the most important parts in developing education in Indonesia, without teachers education will not progress and develop properly. Professional teachers will be able to bring education in a better direction. Law of the Republic of Indonesia Number 14 of 2005) concerning Teachers and Lecturers, Article 2 paragraph 1 states that teachers have a position as professionals at the level of basic education, secondary education, and early childhood education in the formal education pathway appointed in accordance with the laws and regulations. invitation. In the Republic Act it is stated that teacher competence is a set of knowledge, skills, and behaviors that must be possessed, internalized, mastered and actualized by teachers in carrying out their professional duties. Article 10 paragraph (1) of Law Number 14 of 2005 concerning Teachers and Lecturers mandates that teachers must have pedagogic competence, personality competence, social competence, and professional competence. The four competencies are holistic and constitute a unit that characterizes professional teachers. To ensure quality education services in accordance with the demands of the times, increasing this competence is a continuous process.

The Regulation of the Minister of National Education of the Republic of Indonesia Number 16 of 2007 concerning Academic Competency Standards and Teacher Competencies explains that teachers must master four main competencies, namely pedagogical, personal, social, and professional. These four competencies are integrated in teacher performance. Mulyasa (2019) stated that teachers are one of the important aspects in determining the quality of education. Therefore, there is a need for an in-depth study of the competence of teachers in productive learning in the classroom.

Mulyasa (2019) formulates the concept of competence as a combination of knowledge, skills, values, attitudes that are reflected in the habits of thinking and acting. The breakthrough that must be made in the 21st century is that teachers must be able to take advantage of the learning process with the help of technology. The quality of learning will increase when teachers are able to utilize technology that can make teachers learn how to learn and to learn about teaching. Hasib et al (2021) suggest the promotion of diverse media assits students streching their range of learning. Learning in general always applies aspects of pedagogy and content along with the times, so the technological factor becomes a complement for teachers in order to improve the quality of education.

The competence of 21st century teachers, professional teachers are no longer just teachers who are able to teach well, but teachers must be able to become learners and agents of school change. In the 21st century, humans experience the development of science in all fields. One of the most prominent is the field of information and communication. Teachers in the 21st century are challenged to accelerate the development of information and communication. Advances in information and communication technology have increased flexibility in obtaining knowledge for each individual, both teachers and students (Abdurahimovna, 2020).

Consequently, teachers are required to be able to develop approaches and learning strategies in accordance with technological developments. One approach or pattern in learning planning is TPACK (Technological Pedagogical Content Knowledge). One approach to thinking about technology integration in the world of education is Technological Pedagogical and Content Knowledge (TPACK). According to Hidayat (2018), in Harris et al (2014) that basically the application of Technological Pedagogical and Content Knowledge (TPACK) is a competency that must be possessed by teachers in conducting learning in the 21st century. TPACK is a theoretical framework for designing learning models by integrating three aspects The main components are technology, pedagogy, and content. In the learning process, teachers are required to have three competencies at once, namely mastering learning materials according to their field of study, mastering learning methods and strategies, and being skilled in using technology, tools, and learning media. These three demands cannot be separated from one another, but must be integrated and concurrent in the implementation of learning. The learning material must be understood by the teacher because it is the content of the material to be delivered, as well as learning strategies need to be mastered

by the teacher to be effective and efficient in delivering learning material. Learning technology must also be mastered by teachers to strengthen learning strategies so that the achievement of learning objectives is more accelerated. Based on this understanding, the term Technological Pedagogical Content Knowledge (TPACK) emerged. Based on several references, TPACK can be used as a framework for developing learning models and at the same time evaluating the effectiveness of a learning model.

According to Mutiani et al (2020) that breakthrough thinking and novelty is a challenge that must be answered in the 21st century. This challenge must be responded to by education in order to prepare qualified and literate human resources for technological developments. The integration of information, communication, and technology in learning is known as Technological Pedagogical Content Knowledge (TPACK). The integration of technology, pedagogy, and content in the learning process provides a new frame of mind for teachers to improve the learning process and outcomes. TPACK is a framework that can integrate aspects of technological knowledge, pedagogy, and content as a whole so that it creates a new pattern of thinking about combining these three aspects in learning. By integrating the three aspects of technology, pedagogy, and content in learning, of course, it can provide variety in learning.

Based on the results of Utami's research (2019) that in learning students need teaching materials that integrate technology, pedagogy, and content knowledge (TPACK) to achieve optimal learning. For this reason, it is necessary to develop learning materials based on TPACK (Technological Pedagogical Content Knowledge). Furthermore, Shulman (1986) states that TPACK is a comprehensive integration of knowledge and skills in terms of material, and pedagogy that is integrated in technological developments. Ambaryati (2018) in Subhan. (2020) in principle states that a teacher must master Technological, Pedagogical, and Content Knowledge (TPACK).

The development of science and technology can be used as a way to improve the quality of learning carried out by a teacher. To be able to make this happen, a teacher needs to understand and have the ability to Technological Pedagogical Content Knowledge (TPACK), which is the development of Pedagogical Content Knowledge (PCK). TPACK is knowledge to integrate technology into the teaching of certain materials (Suyamto et al., 2020). Besides knowledge about TPACK, motivation, attitude, commitment of teachers and social conditions of teachers also affect the implementation of TPACK.

Suriasumantri (1993) state that knowledge is essentially all what is known about a particular object through scientific reasoning. Knowledge has three components, namely cognitive, affective, and psychomotor components. Meanwhile, the attitude according to Azwar (2012) is that the tendency to act on certain objects. Attitude components consist of cognition, affection, and conation. Cognition is related to memory and thinking, affect is related to feeling, and conation is related to the tendency to act. While motivation is the encouragement of a person to carry out activities to achieve the desired goals (Zhu & Jinxiu, 2012). Meanwhile, according to Winardi (2011) that the motivational component consists of two parts, namely intrinsic and extrinsic motivation. Intrinsic motivation is motivation that comes from within a person, and extrinsic motivation is motivation that comes from outside a person.

Another thing is social conditions, according to Juariyah (2010) that social conditions are a situation where everyone interacts with others and has the opportunity to influence them. Social conditions have five indicators, namely: occupation, age and gender, prestige, household groups, and group membership.

Based on some of the descriptions above, the objectives of this study are to determine: (1) the competence of SMK teachers in implementing TPACK in productive learning in Makassar City; (2) The influence of TPACK knowledge, motivation to apply TPACK, attitudes towards TPACK, teacher commitment to implementing TPACK, and the social conditions of teachers together on the competence of productive teachers to apply TPACK in productive learning at SMK in Makassar City.

Methods

This type of research is quantitative research. The research approach used is correlational research. Correlational research aims to see the relationship and influence of independent variables on the dependent variable. The research location is a State Vocational High School in Makassar City, namely 13 SMK.

The research population is all productive teachers at State Vocational Schools in Makassar City, with a total of 338 teachers. The number of samples refers to the Krejcie Table of Morgan. The sampling technique used is Cluster Random Sampling. Based on the previous description, the sample of this study was 180 productive teachers. The variables of this study consisted of the dependent variable and the independent variable. The dependent variable in this study is the competence of SMK teachers in implementing TPACK in productive learning (Y). The independent variables are: knowledge about TPACK (X1), motivation to apply TPACK (X2), attitude towards TACK (X3), teacher commitment to implement TPACK (X4), and the teacher's social environment (X5).

The data collection technique used in this research is documentation, giving tests and questionnaires to sample teachers to answer. The questionnaire was designed using the Likeker scale, with answer choices from 1 to 5. The details are 1 = Strongly Disagree (STS); 2 = Disagree (TS); 3 = Disagree (KS); 4 = Agree (S); 5 = Strongly Agree (SS). The analytical technique used in this research is descriptive statistical analysis and infrensial statistical analysis. The analysis model is multiple regression with SPSS.

Results and Discussion

Description of Competency of SMK (Vocational School) Teachers Applying TPACK in learning (Y)

The results of descriptive statistical analysis of the competence of productive teachers of State Vocational High Schools in Makassar City applying TPACK are shown in the frequency distribution in Table 1.

Table 1. Frequency distribution in applying TPACK

No.	Description	Shoes	Frequency	Percentage (%)	% kumulatif
1	Very low	10 – 17	0	0	0
2	Low	18 – 25	54	30	30
3	Keep	26 – 33	108	60	90
4	Tall	34 – 41	18	10	100
5	Very high	42 – 50	0	0	-
Sum			180	100	-

Based on Table 1, it can be seen that 30% of SMK teachers in Makassar City have low competence in applying TPACK in learning. As many as 60% have moderate competence. As many as 10% have high competence. The results of further statistical analysis showed that the mean = 27.95; maximum = 35, minimum = 21. The average value is in the medium category. On this basis, it can be concluded that the competence of productive teachers at State Vocational Schools in Makassar City in applying TPACK is moderate.

Knowledge Description About TPACK for SMK Teachers in Makassar City (X1)

The results of descriptive statistical analysis of knowledge about productive teachers' TPACK at State Vocational Schools in Makassar City are shown in the frequency distribution in Table 2.

Table 2. Frequency distribution of teachers' knowledge about TPACK

No.	Description	Shoes	Frequency	Percentage (%)	% kumulatif
1	Very low	1 – 2	0	0	0
2	Low	3 – 4	45	25	25
3	Keep	5 – 6	108	60	85
4	Tall	7 – 8	27	15	100
5	Very high	9 – 10	0	0	-
Sum			180	100	-

Based on Table 2, it can be seen that 25% of productive teachers at State Vocational Schools in Makassar City have low knowledge of TPACK. As many as 60% have knowledge of moderate TPACK. As many as 15% have high TPACK knowledge. The results of further statistical analysis showed that the mean = 5.6; maximum = 7; minimum = 4. The average value is in the medium category. On this basis, it can be concluded that knowledge about the TPACK of productive teachers at State Vocational Schools in Makassar City is moderate.

Description of Vocational Teachers' Motivation to Apply TPACK in learning in Makassar City (X2)

The results of descriptive statistical analysis of the motivation of SMK teachers to apply TPACK in productive learning in Makassar City are shown in the frequency distribution in Table 3.

Table 3. Distribution ofteacher's itivation frequency implementing TPACK in learning in Makassar City

No.	Description	Shoes	Frequency	Percentage (%)	% kumulatif
1	Very low	10 – 17	9	5	5
2	Low	18 – 25	144	80	85
3	Keep	26 – 33	27	15	100
4	Tall	34 – 41	0	0	-
5	Very high	42 – 50	0	0	-
Sum			180	Sum	-

Based on Table 3 above, it can be seen that 5% of productive teachers at State Vocational Schools in Makassar City have very low motivation to apply TPACK. As many as 80% have low motivation to apply TPACK. 15% have moderate TPACK knowledge. The results of further statistical analysis showed that the mean = 22.9; maximum = 30; minimum = 16. The average value is in the low category. On this basis it can be concluded that the motivation of SMK teachers to apply TPACK in learning is low.

Description of SMK Teachers' Attitudes towards TPACK in Makassar City (X3)

The results of the descriptive statistical analysis of teachers' attitudes towards TPACK in Makassar City are shown in the frequency distribution in Table 4.

Table 4. Distribution of frequency of Smk Teacher'sscap against TPACK

No.	Description	Shoes	Frequency	Percentage (%)	% kumulatif
1	Very low	10 – 17	9	5	5
2	Low	18 – 25	99	55	60
3	Keep	26 – 33	72	40	100
4	Tall	34 – 41	0	0	-
5	Very high	42 – 50	0	0	-
Sum			180	100	-

Based on Table 4, it can be seen that 5% of SMK teachers in Makassar City have a very low attitude towards TPACK. As many as 55% have a low attitude towards TPACK. As many as 40% have a moderate attitude towards TPACK. The results of further statistical analysis showed that the mean = 24.8; maximum = 33; minimum = 15. The average value is in the low category. On this basis it can be concluded that the attitude of SMK teachers towards TPACK in Makassar City is low.

Description of Commitment to Implementing TPACK (X4)

The results of the descriptive statistical analysis of the commitment of SMK teachers in implementing TPACK in Makassar City are shown in the frequency distribution in Table 5.

Table 5. Frequency distribution of vocational teacher commitment implementing TPACK

No.	Description	Shoes	Frequency	Percentage (%)	% kumulatif
1	Very low	10 – 17	18	10	10
2	Low	18 – 25	99	55	65
3	Keep	26 – 33	63	35	100
4	Tall	34 – 41	0	0	-
5	Very high	42 – 50	0	0	-
Sum			180	100	-

Based on Table 5, it can be seen that 10% of SMK teachers in Makassar City have a very low commitment to implementing TPACK in productive learning. As many as 55% have a commitment to implement a low TPACK. As many as 35% have a commitment to implement a moderate TPACK. The results of further statistical analysis showed that the mean = 24.45; maximum = 33; minimum = 12. The average value is in the low category. On this basis it can be concluded that the commitment of SMK teachers to apply TPACK in productive learning is low.

Description of Teacher's Social Environment (X5)

The results of the descriptive statistical analysis of the social environment of SMK teachers in Makassar City are shown in the frequency distribution in Table 6.

Table 6. Frequency distribution of vocational teachers' social environment

No.	Description	Shoes	Frequency	Percentage (%)	% kumulatif
1	Very low	10 – 17	0	0	0
2	Low	18 – 25	0	0	0
3	Keep	26 – 33	18	10	10
4	Tall	34 – 41	162	90	100
5	Very high	42 – 50	0	0	-
Sum			180	100	-

Based on Table 6, it can be seen that 10% of the social environment of teachers at State Vocational Schools in Makassar City is classified as moderate. As much as 90% is high. The results of further statistical analysis showed that the mean = 34.6; maximum = 37; minimum = 28. The average value is in the high category. On this basis it can be concluded that the social environment of SMK teachers in Makassar City is high.

The influence and contribution of X1, X2, X3, X4, and X5 together on Y

The results of multiple regression analysis of the influence and contribution of X1, X2, X3, X4, and X5 together are shown in Table 7.

Table 7. The results of the double regression analysis of influence and contribution of X_1,X_2,X_3,X_4,and X_5 together to Y

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1649.242	5	329.848	74.411	.000[b]
	Residual	771.308	174	4.433		
	Total	2420.550	179			
R square = .792 Beta X1 = .518 Beta X2 = .332 Beta X3 = .249 Beta X4 = .305 Beta X5 = .128						

a. Dependent Variable: Y

b. Predictors: (Constant), X5, X3, X1, X4, X2

In Table 7 it can be seen that the significance of F = 0.000 < = 0.05. This shows that X1, X2, X3, X4, and X5 have an effect on Y. R square = 0.792; This means that the magnitude of the effect of X1, X2, X3, X4, and X5 together on Y is 79.20%. There are other variables that are not included in the model that affect Y by 20.80%.

Beta X1 = 0.518; This figure shows that X1 contributes to Y by 0.518. Therefore, if X1 is increased by taking into account X2, X3, X4, and X5, then Y will increase by 0.518.

Beta X2 = 0.332; This figure shows that X2 contributes to Y by 0.332. Therefore, if X2 is increased by taking into account X1, X3, X4, and X5, then Y will increase by 0.332.

Beta X3 = 0.249; This figure shows that X3 contributes to Y by 0.249. Therefore, if X3 is increased by taking into account X1, X2, X4, and X5, then Y will increase by 0.249.

Beta X4 = 0.305; This figure shows that X4 contributes to Y by 0.305. Therefore, if X4 is increased by taking into account X1, X2, X3, and X5, then Y will increase by 0.305.

Beta X5 = 0.128; This figure shows that X5 contributes to Y by 0.128. Therefore, if X5 is increased by taking into account X1, X2, X3, and X4, then Y will increase by 0.128.

Discussion

The competence of SMK teachers to apply TPACK in productive learning in Makassar City is classified as moderate. This competency needs to be improved by providing scheduled training to teachers on TPACK and how to implement it. These competencies are influenced by knowledge about TPACK, attitudes towards TPACK, motivation, commitment to implementing TPACK, and the teacher's social environment.

SMK teachers' knowledge of TPACK is moderate. Therefore, teachers need to receive training on TPACK. If the teacher has received training on TPACK, the teacher's knowledge about TPACK will increase. Increasing this knowledge, the teacher will teach more productively. The attitude, motivation, and commitment of SMK teachers in Makassar City to apply TPACK is low. This is because the

knowledge of the TPACK teacher has not been maximized. In addition, teachers have limited ability about TPACK. Therefore, these variables need to be increased by providing opportunities for teachers to gain experience about TPACK. This experience will increase the competence of teachers to apply TPACK. The social environment of SMK teachers in Makassar City is quite high. This social environment should be maintained. The social environment has a significant influence on the competence of teachers to apply TPACK in productive learning.

Some of the results of research studies that support this research include the results of a study by Rahmadi (2019), that TPACK is a new type of knowledge that must be mastered by teachers to be able to integrate technology well in learning, it can be used as a framework for designing teacher education curricula that are more in line with the era and demands of 21st Century learning. According to Wijaya (2020) research results that TPACK-based learning media can increase student activity for learning, meaning that the motivation and interest of students to take lessons is higher. Furthermore, according to Schmid et al. (2020) that Knowledge, Pedagogical Content, and Technology (TPACK) is considered as one of the most important models that describe the competence of teachers to successfully teach with technology.

The results of research from Tanak, (2018) that the TPACK pedagogical knowledge component has a greater impact on students. In addition, students and teachers demonstrated a combination of technology, pedagogy, and content knowledge, rather than integration of the three. Most of the student teachers use technology as a motivator, but there are no activities to develop TPACK in learning. So technology is only used to provide learning motivation to students. Therefore, teachers must develop TPACK-based learning tools. Technological pedagogical Content Knowledge (TPACK) can be defined as a form of knowledge which is a synthesis of three content/material knowledge, pedagogical knowledge, and technological knowledge. This concept was further developed into TPACK because it added an element of technology (Nofrion, et al, 2018: 108). Technological Pedagogical Content Knowledge (TPACK) is a combination of three knowledge domains (content, pedagogy and technology) which aims to develop basic knowledge when a teacher studies subject matter and understand how technology can improve learning opportunities and experiences for students while knowing the right pedagogy for improve the content of the lesson. Furthermore, the results of research conducted by Yusdiana et al (2019) stated that there was a significant positive direct effect of the teacher's social environment on student achievement and a positive and significant indirect effect of the social environment on learning achievement through motivation. study. According to the results of research from Kodri (2020) that teaching experience has a positive effect on teachers' Technological Pedagogical and Content Knowledge (TPACK), training has a positive effect on teachers' Technological Pedagogical and Content Knowledge (TPACK), training has a positive effect on Technological Pedagogical and Content Knowledge (TPACK) teachers, facilities and infrastructure have a positive effect on the teacher's Technological Pedagogical and Content Knowledge (TPACK), self-efficacy has a positive effect on the teacher's Technological Pedagogical and Content Knowledge (TPACK), as well as motivation has a positive effect on the teacher's Technological Pedagogical and Content Knowledge (TPACK). Therefore, to carry out learning effectively by integrating TPACK in learning, teachers must have knowledge, experience, motivation and a positive attitude towards TPACK. Therefore, it is hoped that teachers will continue to attend training on TPACK.

Conclusion

The conclusions of this study are as follows: (1) The competence of SMK teachers in Makassar City to apply TPACK in learning is in the medium category, and knowledge about TPACK is in the medium category; attitudes, motivation, and commitment to implementing TPACK are in the low category; and the teacher's social environment is high. (2) knowledge about TPACK, attitudes, motivation, commitment, and the social environment of teachers influence together and make a real

contribution to the competence to apply TPACK for productive teachers in SMK (Vocational School) in Makassar City.

Thank-You Note

Acknowledgments are conveyed to: 1) the Chancellor of the Makassar State University; 2) Chairman of the Institute for Research and Community Service (LP2M) Makassar State University; 3) Head of South Sulawesi Provincial Education Office; 4) Head of State Vocational School in Makassar City; 5) Productive Vocational Teachers in Makassar City; 6) All members of the research team, and 7) All parties who have participated in this research. Hopefully the research that has been carried out will provide the maximum benefit to the academics of the Makassar State University, the Society, the Nation and the State.

References

Abdurahimovna, U. F. (2020). The Role of Digital Technologies in the Education System. *Journal La Edusci*, *1*(6), 1-4. https://doi.org/10.37899/journallaedusci.v1i6.258

Azwar, S. (2012). *Sikap Manusia, Teori dan Pengukurannya.* Yogyakarta: Pustaka Pelajar.

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.

Hasib, M., Yassi, A. H., & Nasmilah, N. (2021). Synchronizing Students Learning Styles in Promoting Learners' Grammatical Knowledge; a Cultural Dimensions Study. *International Journal of Multicultural and Multireligious Understanding*, *8*(2), 264-272.

Hidayat, A. (2018). *Kemampuan Tpack (Technological Paedagogical and Content Knowledge) Guru Biologi Kelas X Sma Negeri Se-Surakarta Tahun Ajaran 2017/2018* (Doctoral dissertation, Universitas Muhammadiyah Surakata).

Juariyah, S. (2010). Analisis kondisi sosial ekonomi dan tingkat pendidikan masyarakat Desa Srigading, Kecamatan Labuhan Maringgai, Kabupaten Lampung Timur. *Jurnal Ekonomi dan Pendidikan*, *7*(1).

Kodri. (2020). *Analisis faktor-faktor yang mempengaruhi technological pedagogical and content knowledge (tpack) guru ekonomi*. Tesis: Bandung. Sekolah Pascasarjana Universitas Pendidikan Indonesia.

Mulyasa, E. (2019). *Standar Kompetensi dan Sertifikasi Guru.* Bandung: Remaja Rosdakarya.

Mutiani, M., Supriatna, N., Abbas, E. W., Rini, T. P. W., & Subiyakto, B. (2021). Technological, pedagogical, content knowledge (TPACK): A discursion in learning innovation on social studies. *The Innovation of Social Studies Journal*, *2*(2), 135-142.

Rahmadi. I. F. (2019). *Technological Pedagogical Content Knowledge* TPACK): Kerangka Pengetahuan Guru Abad 2. *Journal of Civics and Education Studies p-ISSN 2302-0865 | e-ISSN 2621-346X*

Schmid, M., Brianza, E., & Petko, D., (2020). Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK) and comparing the factor structure of an integrative and a transformative model. *Published by Elsevier Ltd. https://doi.org/10.1016/j.compedu.2020.103967*

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, *15*(2), 4-14.

Subhan, M. (2020). Analisis Penerapan Technological Pedagogical Content Knowledge Pada Proses Pembelajaran Kurikulum 2013 di Kelas V. *Education and Training*, *1*(2), 174-179.

Suriasumantri, J. S. (1993). *Filsafat ilmu: Sebuah pengantar popular*. Jakarta: Pustaka Sinar Harapan

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), 46-57.

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.

Utami, R. A. (2020). TPACK-Based E-Book for Learning Chemistry in Senior High School. *chemistry*, *40*(60), 60.

Wijaya, T. T., Purnama, A., Tanuwijaya, H. (2020). Pengembangan Media Pembelajaran Berdasarkan Konsep TPACK pada Materi Garis dan Sudut Menggunakan Hawgent Dynamic Mathematics Software. *JPMI – Jurnal Pembelajaran Matematika Inovatif*, 3 (**3**), 205-214.

Winardi, J. (2011). *Motivasi dan Permotivasian Dalam Manajemen*. Jakarta: Raja Grafindo Persada.

Yusdiana, Y. (2019). *Pengaruh Kreativtas Guru, Lingkungan Sosial, Dan Motivasi Belajar Terhadap Prestasi Belajar Ekonomi Peserta Didik Di Sma Negeri 7 Soppeng* (Doctoral dissertation, UNIVERSITAS NEGERI MAKASSAR).

Zhu, Y., & Yang, J. (2012). Effects of farmers' motivation on their participation in publicly funding training programs in Sichuan Province, China. *Journal of Agricultural Science (Toronto)*, *4*(10), 68-74.

Copyrights