J. Pedagogi Hayati Vol. 5 No. 2
©Program Studi pendidikan Biologi
FKIP Universitas Maritim Raja Ali Haji
ISSN 2503-0752 e-ISSN: 2579-4132

Perbedaan Kematangan *Pedagogical Content Knowledge* Guru IPA Berdasarkan Gender dan Masa Mengabdi

Nevrita[1*], Nurul Asikin[2], Bony Irawan[3]

[1*,2,3)] Biology Education Study Program, FKIP UMRAH Tanjungpinang City

Dikirim: Desember 2021; Diterima: Desember 2021; Publikasi: Desember 2021

ABSTRACT. TPACK maturity is an important quality of a modern professional teacher, especially in the current state of the pandemic which requires certain level of technological mastery from teachers. There remain questions as to what variables contributed to TPACK maturity of teachers. The research objective was to examine TPACK maturity among teachers along different tenure lengths and gender. The research was conducted in Tanjungpinang City with a sample of 32 science junior high school teachers consisting of 26 female teachers and 6 male teachers. Data was collected through a questionnaire, assessing 7 aspects of teacher's TPACK. The results show that teachers with less than 12 years tenure length scored higher in TPACK maturity than teachers with 12 to 24 years tenure length, while teachers with more than 24 years tenure length score the lowest. We suggest this result is moderated by the age group variables from the samples. Based on genders, there is no significant difference in TPACK maturity between male teachers and female teachers. The conclusion is that there are differences in the teacher's TPACK maturity based on tenure lengths, but there is no significant difference based on gender.

***Keywords**: TPACK, gender variance, experience, science teacher*

ABSTRAK. Penelitian dan pengembangan keterampilan abad ke-21 melalui penilaian belum banyak dilakukan. Sebelum dilakukan pengembangan, penting untuk dilakukan analisis kebutuhan. Penelitian ini bertujuan untuk menganalisis kebutuhan pengembangan instrumen asesmen autentik keterampilan abad ke-21 untuk mahasiswa pendidikan biologi. Penelitian deskriptif ini menggunakan teknik angket untuk mengumpulkan data berupa respon dosen dan mahasiswa terkait kebutuhan instrumen asesmen autentik keterampilan abad ke-21. Analisis data dilakukan dengan statistik sederhana yaitu persentase dan juga secara kualitatif. Berdasarkan hasil penelitian didapatkan hasil bahwa mahasiswa Pendidikan Biologi mengaku dosen sudah melakukan penilaian keterampilan abad ke-21, namun dosen menganggap belum maksimal dalam menilai keterampilan abad ke-21 karena instrumen yang digunakan dibuat sekedarnya, tidak dikembangkan sebagaimana mestinya (tidak divalidasi), dan belum mengukur keterampilan mahasiswa yang sesungguhnya. Dosen dan mahasiswa menilai penting dilakukan penelitian dan pengembangan instrumen asesmen autentik untuk keterampilan abad ke-21. Berdasarkan hasil penelitian dapat disimpulkan bahwa keterampilan abad ke-21 yang perlu dikembangkan menggunakan instrumen asesmen autentik yang dimaksud serta alat ukurnya adalah keterampilan berpikir kritis menggunakan tes, berpikir kreatif dan komunikasi menggunakan lembar observasi, dan keterampilan berkolaborasi menggunakan *self assessment*.

Kata Kunci: analisis kebutuhan, keterampilan abad ke-21, mahasiswa pendidikan biologi

*Penulis korespondensi
Alamat surel: nevrita@umrah.ac.id

©Program Studi pendidikan Biologi
FKIP Universitas Maritim Raja Ali Haji
ISSN 2503-0752 e-ISSN: 2579-4132

INTRODUCTION

Teacher competence has always been used as a reference for the success of education in Indonesia, in addition to the four competencies that teachers must have, other competencies are that are also important models for showing the success of teaching teachers' competencies in utilizing technology, namely TPACK competence (Technological pedagogy and content knowledge). Initially, TPACK's competence was only three aspects, there were no technological aspects, with the development of teaching in the 21st century which was technology-oriented so that the technological aspects were added. Technology, in a broad sense, is knowledge, creation, and use of tools and techniques to control and adapt to the environment [1]. Technology has a significant impact on improving the quality of education. The importance of integrating technology in education will help students learn and teachers to carry out the teaching profession more effectively [2].

The integration of technology in teaching is seen as important in response to the challenges of the globalization era marked by the rapid development of ICT [3]. Technology has enhanced education and brought specific benefits that can be leveraged in the context of professional education where competencies and determined outcomes are consistently articulated, tracked, and provide a clear and explicit educational framework in which new approaches to integrating technology can be supported [4]. Teachers need to improve their teaching abilities to implement learner-centered and technology-supported education. Teachers must have pedagogical knowledge, appropriate content and, technology, and aspects to able to use learner-centered technology [5]. The point is that technology is indispensable in today's learning so that teachers must integrate technological knowledge with pedagogical knowledge and content, use technology effectively in teaching and learning, this is supported by strong empirical evidence that teaching technology skills separately does not lead to improved teaching and learning with technology [6] [7]. The teacher's ability to master and integrate the four aspects of learning is known as TPACK.

Technological Pedagogical Content Knowledge (TPACK) functions as theories and concepts for researchers and educators in measuring the readiness of prospective teachers and teachers to teach effectively with technology [8]. For technology integration in TPACK, teachers must master all aspects of TPACK, and collaborate on all aspects of learning. TPACK is the basis of effective teaching with technology, which requires an understanding of the representation of concepts using technology; pedagogical techniques that constructively use technology way to teach content; knowledge of what makes concepts difficult or easy to learn, and how technology can help correct some of the problems students face; knowledge of the student's previous knowledge and theory of epistemology; and knowledge of how technology can be used to build on existing knowledge to develop new epistemologies or strengthen old ones " [9]. Previous studies on teacher TPACK competencies have been carried out, including TPACK competencies which are more specific to see the ability to use and utilize learning media.

During learning in the classroom the teacher must use learning media to clarify the information conveyed to students. Many types of instructional media can be selected and used by the teacher, so in choosing instructional media the teacher must have the ability and knowledge of the media itself. Not all media are suitable for all materials, so the teacher's carefulness in choosing suitable media also determines the success of the teacher in teaching. Learning media plays an important role in the learning process, appropriate and quality media will help and facilitate teachers and students in achieving learning goals [10].

The Tanjungpinang City Junior High School Science Teachers have utilized learning media while in class, most of the learning media that are mostly used by Tanjungpinang Junior High School IPA teachers are PowerPoints, videos, pictures, and props available in the laboratory or not. This is by the results of previous research that the science teachers of Tanjungpinang City Junior High School have used learning media, and integrating simple technology in the form of PPT in learning media [11]. However, research on TPACK, especially learning media, has never been carried out for IPA teachers at Tanjungpinang City Junior High School. Likewise, linking it to the tenure and gender of the teacher has not been done for science teachers at Tanjungpinang City. Through the research that will be carried out, the writer can provide an analysis of how the TPACK ability, especially in the use of teaching media for junior high school science teachers in terms of tenure and gender.

©Program Studi pendidikan Biologi
FKIP Universitas Maritim Raja Ali Haji
ISSN 2503-0752 e-ISSN: 2579-4132

Mengembangkan keterampilan abad ke-21 melalui penilaian autentik bagi mahasiswa calon guru sangat direkomendasikan dengan harapan guru kedepannya tidak hanya melek penilaian tetapi juga kompeten dalam merancang dan menggunakan asesmen autentik untuk mendukung pembelajaran siswa dan penguasaan kompetensi abad ke-21 (Koh, 2017). Dengan demikian diharapkan keterampilan abad ke-21 peserta didik juga berkembang. Sebelum mengembangkan asesmen autentik untuk mengukur keterampilan abad ke-21 bagi mahasiswa pendidikan biologi, maka perlu dianalisis apa saja yang dibutuhkan. Analisis kebutuhan merupakan tahap awal pada sebagian besar model pengembangan produk penilaian (Purwanti et al., 2020), (Afrida, Indah, 2016).

METHOD

This research was conducted at the Tanjungpinang City State Junior High School with 32 SMP IPA teachers, namely 6 male teachers and 26 female teachers. To find out the TPACK competency in terms of tenure, all teachers will be sampled, while to find out the TPACK competency in terms of gender the researcher will only select 6 female teachers to balance the number of male teachers who are also only 6 teachers. The working period of all teachers is divided into three ranges, namely <12 years, between 12-24 years, and> 24 years. This research is descriptive research that seeks to describe and interpret the object or subject under study according to what it is. This research is very simple, easy to understand without complex statistical techniques but can be presented in a more complex form [12]. The research instrument was a closed questionnaire on a Likert scale consisting of strongly agree, agree, don't agree, and disagree which contains seven aspects of TPACK consisting of TK, PK, CK, PCK, TCK, TPK, TPACK. The instrument has gone through a trial phase to measure the validity and reliability, the instrument validity test uses the Pearson Bivariate Correlation. Data analysis was carried out by descriptive analysis and strengthened by one-way ANOVA. Observations could not be made by researchers because during this research period the learning process was carried out online due to the 2019 covid pandemic, so researchers could only collect data through questionnaires. The instruments from the seven aspects of TPACK are detailed in Table 1 below. Observations could not be carried out by researchers because during this research period the learning process was carried out online because of the 2019 covid pandemic, so researchers could only collect data through questionnaires. The instruments from the seven aspects of TPACK are detailed as shown in Table 1 below.

Table 1. Research instrument

No.	Aspect	Indicator	No. Statement
1.	*Technical Knowledge*	The ability of teachers to use IT	1
		The teacher's ability to operate word, excel, and PPT	2
		The teacher's ability to create and operate PPT	3
		The teacher's ability to use biological equipment in the laboratory	4
		Understand the function of simple tools for experiments	5
2	*Pedagogical Knowledge*	The teacher knows various media	6
		The teacher's ability to use various media	7
		The teacher's ability to develop media	8
		The ability of the teacher to use learning media in the laboratory	9
3	*Content Knowledge*	Teachers master all science material	10
		Teachers only master the material being taught	11
		Teachers only master their field of knowledge	12
4	*Pedagogical Content Knowledge*	Teachers master the right strategies in using media	13
		Teachers can choose suitable learning media	14
		The teacher evaluates to determine the	

©Program Studi pendidikan Biologi
FKIP Universitas Maritim Raja Ali Haji
ISSN 2503-0752 e-ISSN: 2579-4132

		usefulness of learning media	15
5	*Technological Content Knowledge*	The teacher makes learning media for certain materials by using the internet	16
		Teachers are looking for various media using the internet	17
		Teachers can design instructional media	18
6	*Technological Pedagogical Knowledge*	Teachers use IT in learning	19
		Teachers can make simple non-technological media	20
		Teachers use web/blog/email in submitting assignments	21
		Teachers use IT in processing learning outcomes	22
7	*TPACK*	Teachers can operate ICT in teaching material using media	23
		The teacher can choose the tools and materials (non-ICT media) used for teaching.	24

All answers will be sorted first based on the length of service and then again sorted by gender. All answers will be analyzed using Table 2 below.

Table 2. TPACK instrument Likert Scale score

No.	Likert scale	Score
1.	Strongly agree	4
2.	Agree	3
3.	Don't agree	2
4.	Disagree	1

b. Reliability Statistics

Table 5. Reliability statistics

Cronbach's Alpha	N of Items
,957	24

All the answers from the questionnaire were examined one by one, the percentage of answers from the Likert scale score was then combined for each aspect of the TPACK so that it was known how many percent answered strongly agreed, agreed, disagreed, and disagreed. And so on, what is done until the seventh aspect. The percentage of the results of the Likert scale analysis for each aspect of TPACK will be interpreted to find out which each aspect is in what category will then be averaged so that the results will be described in Table 3 below.

Table 3. Score interpretation criteria [13]

TPACK Profile (%) Score	Category
81-100	Very good
61- 80	Well
41- 60	Enough
21- 40	Not good
0- 20	Not very good

Through Table 4 above, it will be seen that every aspect of TPACK's competence is in the right category, then it is reduced as a whole so that it is known that the TPACK competency of science teachers is based on tenure and gender.

RESULTS AND DISCUSSION

(TPACK competencies are based on the work tenure of SMP science teachers)

The validity test using the person bivariate correlation obtained data that of the 24 statements in the closed questionnaire were declared valid because the R-count was greater than the R-table 0.404 and also supported by the reliability results using the Cronbach Alpha formula with SPSS obtained r 0.957 greater than 0.6 so that the questionnaire is declared reliable. As stated in the following SPSS results.

Table 4. Results of Validation and instrument reliability
a. Case Processing Summary

		N	%
Cases	Valid	22	100,0
	Excluded[a]	0	,0
	Total	22	100,0

a. Listwise deletion based on all variables in the procedure.

©Program Studi pendidikan Biologi
FKIP Universitas Maritim Raja Ali Haji
ISSN 2503-0752 e-ISSN: 2579-4132

The results of this study will be analyzed according to the research objectives, namely based on the tenure and gender of the Tanjungpinang City Junior High School Science teacher. The working period of teachers is divided into 3 groups, namely the working period > 12 years, the working period of 12-24 years, and the working period> 24 years. The division of work tenure is based on the researcher's calculation that the service period of civil servants until their retirement is a maximum of 36 years when calculated from the age after completing the Bachelor's education. So that 36 years are divided into three to make it easier to perform data analysis, then the division is as written above. Based on the analysis of teacher tenure <12 years, it is illustrated in Table 6 below.

Table 6. The ability of TPACK Junior High School Science Teacher with a service period of <12 years

NO	TPACK aspect	Percentage (%)	Category
1	*Technological Knowledge (TK)*	91	Very Good
2	*Pedagogical Knowledge (PK)*	81	Very Good
3	*Content Knowledge (CK)*	51	Enough
4	*Pedagogical Content Knowledge (PCK)*	89	Very Good
5	*Technological Content Knowledge (TCK)*	94	Very Good
6	*Technological Pedagogical Knowledge (TPK)*	87	Very Good
7	*Technological Pedagogy and Content Knowledge (TPACK)*	96	Very Good
	Average	84	

Of the 7 aspects of TPACK, only the CK aspect is in the good enough category, this is because the science material in SMP consists of three fields of science, namely biology, physics, and chemistry. Of the 24 teachers whose tenure is less than 12 years, only 50% of the master all science material, 50% of science teachers only master the material being taught which is by following per under their scientific fields. So it can be stated that the competency of TPACK science teachers with a service period of fewer than 12 years is in the very good category. Next, the TPACK ability of science teachers with a working period of 12-24 years can be seen in Table 7 below.

Table 7. The ability of TPACK Junior High School Science Teacher with a working period of 12-24 years

No	TPACK aspect	Percentage (%)	Category
1	*Technological Knowledge (TK)*	80	Very Good
2	*Pedagogical Knowledge (PK)*	64	Well
3	*Content Knowledge (CK)*	62	Well
4	*Pedagogical Content Knowledge (PCK)*	81	Very Good
5	*Technological Content Knowledge (TCK)*	81	Very Good
6	*Technological Pedagogical Knowledge (TPK)*	61	Well
7	*Technological Pedagogy and Content Knowledge (TPACK)*	86	Very Good
	Average	74	

From Table 8 above, the TPACK ability of teachers with a working period of 12-24 years is in the good category with a percentage of 74%. The conclusion is that teachers who have worked between 12-24 years have good TPACK abilities. However, the TPACK ability of teachers who are over 24 years of service shows results that are far different from their previous tenure. Incidentally, there is only one teacher whose work period is over 24 years, the results of the research from the teacher obtained that all aspects of TPACK are in disagreeing answers and if converted is in the fairly good category as shown in Table 8 below.

Table 8. The ability of TPACK Junior High School Science Teacher with a service period of > 24 years

No	TPACK aspect	Percentage (%)	Category
1	*Technological Knowledge (TK)*	50	Enough

©Program Studi pendidikan Biologi
FKIP Universitas Maritim Raja Ali Haji
ISSN 2503-0752 e-ISSN: 2579-4132

2	*Pedagogical Knowledge (PK)*	50	Enough
3	*Content Knowledge (CK)*	50	Enough
4	*Pedagogical Content Knowledge (PCK)*	50	Enough
5	*Technological Content Knowledge (TCK)*	50	Enough
6	*Technological Pedagogical Knowledge (TPK)*	50	Enough
7	*Technological Pedagogy and Content Knowledge (TPACK)*	50	Enough
	Average	50	

The results of the descriptive data analysis above are strengthened by one-way ANOVA test data analysis using SPSS as shown in Figure 2. From this test, it is proven that there is a difference in TPACK competence when viewed from the teacher's tenure. This is evidenced by the F-count 5,434 obtained is greater than the F-table 4,18. Likewise, the sig level 0.010 is smaller than 0.05.

Table 9. One-way ANOVA test data analysis for tenure

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	1,526	2	,763	5,434	,010
Within Groups	4,072	29	,140		
Total	5,598	31			

From the research results, it can be seen that the length of service does not determine the teacher's TPACK competency [14]. This statement is supported by the statement that technology integration does not have a direct effect on teacher seniority but has an indirect effect on TPACK, teacher technology integration decreases as the teacher becomes more senior [5]. The two opinions above contradict the two opinions following those teachers who teach longer have better competence than teachers who have little teaching experience. teachers who have long teaching experience can produce more effective teaching because experienced teachers consider teaching as an art, while teachers who are new to their profession think that teaching is only the process of imparting knowledge to students[15] [16].

However, from the researcher's analysis, because professionalism and competence here are measured through the ability of teachers to use learning media that emphasizes technology and its integration during the learning process, teachers with long tenure have less ability and skills to use technology-integrated learning media compared to teachers with new tenure. This agrees with the statement of young teachers who still have the enthusiasm to continue learning and developing themselves, while older teachers have less enthusiasm for learning because they feel they are already inadequate and are soon entering retirement [17]. Another opinion that supports the research results is that the length of teaching experience is not directly proportional to the increase in TPACK ability. This is influenced by the busyness faced by senior teachers so which causes senior teachers not to take the time to learn new things, especially technological advances in supporting the teaching process in the classroom [18].

(TPACK competencies based on gender)

The results obtained through a questionnaire analysis of the TPACK ability of junior high school science teachers based on gender were obtained as shown in Table 10 below.

Table 10. The ability of TPACK Junior High School science teacher is female

No	**TPACK aspect**	**KS (%)**	**Category**
1	*Technological Knowledge (TK)*	70	Well
2	*Pedagogical Knowledge (PK)*	75	Well
3	*Content Knowledge (CK)*	59	Enough
4	*Pedagogical Content Knowledge (PCK)*	94	Very Good
5	*Technological Content Knowledge (TCK)*	83	Very Good
6	*Technological Pedagogical Knowledge (TPK)*	83	Very Good
7	*Technological Pedagogy and Content Knowledge (TPACK)*	75	Well
	Average	77	Well

Based on Table 10 above, there is a balanced category for each aspect between the very good and good categories, if the average TPACK ability of female teachers is in the good category. Of the seven aspects, CK's ability is in the quite good category.

©Program Studi pendidikan Biologi
FKIP Universitas Maritim Raja Ali Haji
ISSN 2503-0752 e-ISSN: 2579-4132

The CK aspect is in a different category because in the CK aspect not all teachers master all subject matter, most teachers only master material that is their area of expertise, so that female teachers who have biology expertise are only able to master biology. ingredient. material too. as a teacher with only a background in physics and chemistry mastering physics and chemistry. For the aspects of kindergarten, PCK, TCK, and TPACK female teachers are in the very good category, this is supported by [19]. Yang found that female teachers' CK, PK, PCK, and TCK scores were higher than male teachers. From the 4 aspects of TPACK, according to Altun, there are two aspects of TPACK that support the results of the author's research, namely TCK and PCK. The TPACK aspect of female teachers is also supported by other studies which state that female teachers have a higher TPACK level than male teachers [20]. In junior high schools, although science is an integrated subject, in the implementation of the Tanjungpinang City Junior High School, teachers still teach according to their scientific fields. Table 9 below is an analysis of the results of the TPACK competency questionnaire for male junior high school science teachers. The results of this analysis can be seen in Table 11 below.

Table 11. The ability of TPACK junior high school science teacher is male

No	TPACK aspect	Percentage (%)	Category
1	*Technological Knowledge (TK)*	70	Well
2	*Pedagogical Knowledge (PK)*	54	Enough
3	*Content Knowledge (CK)*	44	Enough
4	*Pedagogical Content Knowledge (PCK)*	61	Well
5	*Technological Content Knowledge (TCK)*	72	Well
6	*Technological Pedagogical Knowledge (TPK)*	46	Enough
7	*Technological Pedagogy and Content Knowledge (TPACK)*	84	Very Good
	Average	62	Well

The results of the descriptive analysis above are strengthened by the results of the one-way ANOVA test as shown in table 12 below, from the results of the test analysis it turns out that F-count 0.225 is smaller than F-table 4.96 and the sig value 0.645 is greater than 0.05, so It is explained that there is no difference in teacher TPACK competence in terms of gender.

Table 12. Analysis of one-way ANOVA test data for gender

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,059	1	,059	,225	,645
Within Groups	2,627	10	,263		
Total	2,686	11			

Based on table 12, it can be seen that several aspects are in the quite good category if described one by one male teacher, the aspects of PK, CK, and TPK are in the quite good category for male teachers, in contrast to female teachers who from the three aspects are only CK only which is good enough. Male teachers' TK aspects are in a good category, this is by following per under other studies, there are significant differences between the gender of the teacher and the TK aspect, male teachers have higher TK aspects than female teachers, male teachers have more time and opportunity in developing themselves while female teachers according to their conditions must be able to divide their roles in teaching and managing the household [21] [22].

The results of the TPACK SMP science teacher competency research were based on gender differences showing different results from other studies there was no significant difference in competence between male and female teachers, male and female teachers had the same level of competence, teacher competence was not influenced by experience the length of teaching regardless of the length of time a teacher teaches will not make the teacher increase in quality [23] [24] [25]. Another statement that there is a significant difference between male and female teachers, however, female teachers have a relatively high awareness of male teachers [26]. Although the results of research from several other researchers differ from the results of the author's research, it cannot be the same because the research subjects and areas are different and this

©Program Studi pendidikan Biologi
FKIP Universitas Maritim Raja Ali Haji
ISSN 2503-0752 e-ISSN: 2579-4132
is also influenced by the number of samples in this very small study.

CONCLUSION

From the results of the research above, it can be concluded that tenure affects the ability of TPACK in the learning media of teachers who are working. The work period of fewer than 12 years has very good abilities, teachers with a working period of 12-24 years the ability of TPACK learning media is in a good category, while teachers with a working period of more than 24 years are in the quiet good category. This shows that there are differences in the length of work on the ability of TPACK, especially in the use of science learning media at SMP Tanjungpinang, this is also reinforced by the results of the one-way ANOVA test. The ability of the SMP science teacher TPACK learning media when analyzed from gender differences shows that there is no difference in TPACK competence, this is also supported by the one-way ANOVA test results which indicate that there is no difference in TPACK competence. teachers in terms of gender. The benefit of this research is that the local government conducts regular training, especially in the use of learning media for all teachers, not only for new teachers but also for teachers who have worked for a long time. Teachers with long tenure must always be educated in their knowledge so that their competencies are comparable to those of newly appointed teachers. The benefits for the school as a result of this research can be used as a reference and guide so that teachers in their learning try to improve their TPACK abilities, especially in the use of instructional media. For further research from this study, researchers will develop the TPACK instrument, especially in the use of valid, effective, and practical teacher learning media.

ACKNOWLEDGMENTS

Thank you to LP3M and UMRAH Finance department who have funded this research and publication. Thank you also to the IPA teachers of Tanjungpinang City Junior High School who have been willing to provide data and information for this research.

REFERENCES

Agustini K., Santyasa IW, Ratminingsih N M. 2019. Analysis of competence on "TPACK": 21st-century teacher professional development. Journal of Physics: Conference Series. 1387 (1): 1-9

Altun T. 2013. Examination of classroom teachers' technological pedagogical and content knowledge based on their demographic profiles. Croatian Journal of Education. 15 (2), 365-397

Andrade AB, Gonzales MC, Martin SC. 2020. Digital competencies relationship between gender and generation of university professors. International Journal on Advanced Science, Engineering and Information Technology. 10 (1): 205-211

Angeli C, Valanides N, Christodoulou A. 2016 Theoretical considerations of technological pedagogical content knowledge. In M. Herring, MJ Koehler, & P. Mishra (Eds.), Handbook of Technological Pedagogical Content Knowledge. 2nd Editio: 21-42

Borkoh, Whitcomb J, Liston D. 2009. Wicked problems and other thoughts on. Journal of Teacher Education. 60(1): 3-7

Goktas Y. Yildrim S, Yildrim Z. 2009. Main barriers and possible enablers of ICTs integration into pre-service teacher education programs. Journal of Educational Technology & Society. 12 (January): 193-204

Hermawan I. 2019. Metodologi penelitian pendidikan kuantitatif, kualitatif dan mixed metode. Jakarta: Hidayatul Quran Kuningan

Karaca F. 2015. An investigation of preservice teachers' technological pedagogical content knowledge based on a variety of characteristics. International Journal of Higher Education. 4 (4): 130-136

Koehler MJ, Mishra, P. 2009. What is technological pedagogical content knowledge ?. Contemporary Issues in Technology and Teacher Education. 9 (1): 60- 70.

Lestari E. 2016. The Relationship between Educational Background and Length of Teaching History Teachers with History Learning Outcomes in High School Students. Edumatica. 2 (1): 288-257.

Nainggolan R. 2016. Pengaruh pengalaman mengajar terhadap kompetensi guru (lembaga pendidikan non profit). The Progressive and

©Program Studi pendidikan Biologi
FKIP Universitas Maritim Raja Ali Haji
ISSN 2503-0752 e-ISSN: 2579-4132

Fun Education Seminar. ISBN: 978-602-361-045-7. Pp. 7-13

Nevrita N, Asikin N, Amelia T. 2020. Analisis kompetensi tpack guru melalui media pembelajaran biologi SMA. Indonesian Journal of Science Education. 8 (2): 203-217

Nevrita. 2018. The use of learning media by junior high school teachers of science in Tanjungpinang and Bintan. 2 (1): 1-8

Ozudogru M, Ozudogru F. 2019. Technological pedagogical content knowledge of mathematics teachers and the effect of demographic variables. Contemporary Educational Technology. 10 (1): 1-24

Paidi, Subali B, Pradana SP, Antony MK. 2020. Biology teacher's TPACK profile in central Java: description of TPACK mastery based on teaching experience. International Conference on Educational Research and Innovation (ICERI 2019). 401 (ICERI 2019): 28-32

Pedagogical, and Content, Knowledge) guru biologi SMA dalam menyusun perangkat pembelajaran materi sistem peredaran darah. Inkuiri: Jurnal Pendidikan IPA. 9 (1): 46-57

Riduan & Sunarto. 2011. Pengantar Statistik Untuk Penelitian Pendidikan, Sosial, Ekonomi, Komunikasi, dan Bisnis. Bandung: Alfabeta

Sahari. 2015. Pengaruh Pendidikan, Pelatihan, dan Pengalaman Mengajar terhadap Profesionalisme Guru Di SMAN I Likupang. Jurnal Pendidikan Islam Iqra. 9 (1): 62-86

Saubern R, Henderson M, Heinrich E, Redmond P. 2020. Editorial TPACK – time to reboot ?. Australasian Journal of Educational Technology. 36 (3): 1-9

Sezer B. 2015. Examining techno pedagogical knowledge competencies of teachers in terms of some variables. Procedia - Social and Behavioral Sciences. 174: 208-215

Smith EE, Kahlke R, Judd T. 2020. Not just digital natives: Integrating technologies in professional education contexts. Australasian Journal of Educational Technology. 36 (3): 1-14

Sukarti S. 2013. Isu gender dan sertifikasi guru versus prestasi belajar siswa. Jurnal Pendidikan. 14 (1): 38-43

Suryawati E, Firdaus L, Hernandez Y. 2014. Analisis keterampilan technological pedagogical content knowledge (TPCK) guru biologi SMA negeri kota Pekanbaru. Journal Biogenesis. 11 (1): 67-72

Suyamto J, Masykuri M, Sarwanto S. 2020. Analisis kemampuan TPACK (Technolgical,

Syukur IA, 2014. Teacher professionalism In implementing information and communication technology in nganjuk district. Jurnal Pendidikan dan Kebudayaan.20 (2): 200-210

Uslu O. "Factors associated with technology integration to improve instructional abilities: a path model factors associated with technology integration to improve instructional". Australian Journal of Teacher Education

Yurizki D, Murniati M, Syahrun N. 2018. Kompetensi pedagogik dan profesional guru dalam peningkatkan hasil belajar fisika peserta didik SMAN di wilayah barat Kabupaten Bireuen. Jurnal Pendidikan Sains Indonesia. 6 (2): 68-74