Competency Analysis of Technological Pedagogical and Content Knowledge (TPACK) Biology Teachers

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Abstract: TPACK competence of teachers can improve the quality of learning in accordance with the demands and changes. Information on TPACK competencies is needed regarding the ability of teachers to know the professional development of teachers. This study aims to determine the competence criteria of biology teachers in Aceh Province in the components of CK, TK, PK, PCK, TCK, TPK, and TPACK, to find out the significant differences in TPACK competence of biology teachers based on teacher certification and teaching experience. This type of research is descriptive with a quantitative approach. The population in this study were all Biology teachers at state high schools in Aceh Province, namely civil servants, and non-civil servants, totaling 692 teachers. Sampling using a simple random sampling technique, obtained 232 respondents which is a total of 33.53% of the number of teachers in each district. The research instrument in the form of a questionnaire was adapted from Schmidt which consists of 38 items and has gone through face validity. Data analysis for the TPACK component is described according to the predicate criteria. The TPACK competence of biology teachers based on certification was analyzed by independent sample t-test, while the TPACK competencies of biology teachers based on teaching experience were analyzed using ANOVA. The results showed that the highest competency criteria for the TPACK component were PK with a score of 83.35% (very good), while the lowest was TK with a score of 76.84% (good). The results also showed that there was no significant difference (p> 0.05) in the TPACK competence of biology teachers based on certification and teaching experience.

Keywords: TPACK; Biology teacher; Certification and Teaching experience.

Introduction

Learning difficulties of students are known based on the results of the evaluation. Evaluation as a diagnostic function is to find out the causes of students experiencing learning difficulties (Nduru, 2015). Idrus (2019) also explains that evaluation is a measuring tool or process to find out the level of achievement of student success on teaching materials or materials that have been delivered, so that with an evaluation the objectives of learning will be seen accurately and convincingly. Bakri (2021) stated that the results of the evaluation of the average Scholastic Potential Test (SPT) for high school students in Aceh Province in 2021 for the UTBK SBMPTN showed a ranking of 24 for science and technology and 26 for social and humanities nationally, the same as the previous three years. This shows that the quality of education in high school is not better.

Teacher competence affects the quality of education. Arfah and Muhidin (2018) state that teacher

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professional competence has a strong and significant positive relationship with student learning outcomes. The low competence of teachers is also one of the causes of students' learning difficulties. Firdaus (2014) and Mutakin (2015) explain the low competence of teachers because teachers have not or do not work seriously, the professional abilities of teachers are still lacking, and the professionalism of teachers is very dependent on the expertise and level of education taken.

Teacher competence is a set of knowledge, skills, and task behaviors that must be possessed and realized in carrying out professional duties in the classroom. The factors that influence teacher competence include educational background, teaching experience, and length of teaching (Spencer, 1993 in Musfah, 2012). The experience gained by the teacher during teaching provides an advantage, namely knowing the relative need for knowledge because the higher the teaching experience of a teacher, the better his ability to work (Artika, 2018; Eliyanto and Wibowo, 2013).

The length of the teaching period for teachers can also provide more opportunities for efficient learning activities so that they can make necessary program adjustments in the next lesson. Teacher competence should continue to increase along with the times so as not to hinder the learning process of students in the future because teacher competence is closely related to national education goals so future teachers must have good quality and quality (Mutakin, 2015).

Improving the quality of teachers is directly proportional to the improvement in the quality of education. One of the efforts that can be taken is to improve the professional competence of teachers. Professional teachers are teachers who have participated in professional programs and have obtained teacher certification. Based on the explanation of Koswara and Rasto (2016) there is a significant difference between the competencies of teachers who have followed professional certification and those who have not followed professional certification. Teachers who have followed professional certification have higher performance, teacher certification has a positive impact on increasing teacher competence and performance. The use of technology in the learning process in the 21st century supports the achievement of the learning objectives set. This is in accordance with Permendikbud No. 16 of 2007 which states that a teacher must have competence in the field of information and communication technology which functions to develop themselves and support the learning process. This relates to the goals of national education and the knowledge framework that a teacher should master in the 21st century, namely Technological Pedagogical and Content Knowledge (TPACK) (Koehler and Mishra, 2009; Rosyid, 2016).

TPACK is the knowledge that teachers have about how to facilitate student learning of certain content through pedagogical and technological approaches (Cox and Graham, 2009). TPACK is known in the research field as a framework for designing learning models by integrating three main aspects, namely technology, pedagogy, and content (Koehler and Mishra, 2009). This TPACK framework has a significant impact on teachers because it can describe the various types of knowledge needed by teachers to teach effectively with the help of technology and complex combinations in the field of knowledge (Rosyid, 2016).

TPACK ability is very important for a professional teacher. This is in accordance with Law Number 14 of 2005 Article 10, the four main competencies of a teacher obtained through professional education include pedagogical competence, personality competence, social competence, and professional competence, TPACK is in these four domains (Nofrion et al., 2018). The head of the UPTD Balai Tekkomdik Aceh Education Office also stated that the use of technology is one of the teacher competencies among several other competencies that must be developed for the advancement of education and facilitate the teaching and learning process in Aceh (Editor, 2020).

Regarding teacher competence, data obtained from the Regional Education Balance (NPD) shows the results of the Teacher Competency Test (UKG) with the UKG value of middle and high school teachers in Aceh Province being in the third lowest rank with a scale of 45.49 and 51.05 from the national scale. This is of course in line with literature studies that have been carried out in Aceh Province, namely in Aceh Besar District and Banda Aceh City which noted that the TPACK competence of science teachers was still lacking (Nurina, 2019; Yulisman, 2019; Wulansari et al., 2019).

The lack of teacher TPACK competence affects the learning process. Biology learning in particular is often faced with abstract material and outside the daily experience of students, so that the material becomes difficult to teach and difficult for students to understand. There are also many materials in Biology that cannot be visualized directly, so it takes certain media to make it look real. According to Jayawardana (2017), with the visualization of Biology material using digital media, it is hoped that students will find it easier to understand Biology materials. Teachers are expected to be able to convey material in a more interesting and easy-to-learn manner by packaging it in a digital format to make it easier for teachers and students to achieve learning goals. Constructive learning related to content can support the biology learning process. Nasar and Daud (2020) explain learning related to TPACK, namely as a unit to understand how forms of knowledge interact with each other, referring to understanding how to represent concepts with the help of technology,

pedagogical techniques that use technology in a constructive way to teach content, knowledge about difficult concepts become easy to learn and how technology can help students learn and knowledge of how technology can be used to build on existing knowledge. Based on this explanation, TPACK supports abstract biology learning so that it can be visualized with technology and constructively.

Information on TPACK competencies is needed to improve teacher knowledge and skills in integrating educational technology to face educational challenges in the Industrial 4.0 era (Wulansari et al., 2019). The results of previous research on TPACK generally focused on pre-service (pre-service) teachers and were small in scope, while TPACK for in-service (in-service) teachers had not been analyzed further. (Koçoglu, 2009; Nasar and Daud, 2020; Nofrion et al., 2018; Pamuk, 2011; Rahmadi, 2019; Schmidt et al., 2021). The TPACK criteria for biology teachers in State Senior High Schools in Aceh Province are based on teaching experience, and teacher certification has not been studied. The TPACK competence of Biology teachers in State Senior High Schools in Aceh Province as a whole for each component has also not been studied.

Method

This type of research is descriptive with a quantitative approach. This research took place in Aceh Province, took place in May-July 2021. The population in this study were all State High School Biology teachers in Aceh Province, namely Civil Servant and non-Civil Servant teachers, totaling 692 people. The sample was determined by a simple random sampling technique, namely 232 respondents, namely 33.53% in each district. The research instrument was adapted from Schmidt et al. (2009) which consists of 38 items. All instrument items have been tested for validity, namely face validity, and reliability tests were carried out using Cronbach alpha.

The data collection technique used is a questionnaire. The data obtained were then tabulated for analysis. The data was obtained through an online survey using Google Form.

Data analysis for the TPACK component is described according to the predicate criteria. The grouping of TPACK component data is done by adding up the scores obtained on each instrument. The equation used to convert the score obtained into a percentage can be seen in equation 1. The score obtained

$$Values = \frac{The\ score\ obtained}{maximum\ score}\ x\ 100\%.................................\ (1)$$

The criteria for the TPACK component are made on a rating scale following the range and description with the following predicates in Table 1.

Table 1. Percentage Range and Qualitative Criteria

Renge	Qualitative Criteria
0 – 20	Very less
21 – 40	Not enough
41 – 60	Enough
61 – 80	Good
81 – 100	Very good

(Sugiyono, 2017)

The TPACK competence of biology teachers based on teaching experience was analyzed using Analysis of Variance (ANAVA), while the TPACK competencies of biology teachers based on certification were tested by independent sample t-tests, both analyzes used SPSS (Statistical Program For Social Science) 23.0 for windows.

Result and Discussion

Teacher competency criteria analysis

TPACK criteria data obtained from biology teachers in State Senior High Schools in Aceh Province can be seen in Table 2.

Table 2. Percentage of TPACK Criteria for Biology Teacher Competence in Aceh Province

Componen TPACK	Values (%)	Criteria
Content Knowledge (CK)	80.98	Very good
Technological Knowledge (TK)	76.84	Good
Pedagogical Knowledge (PK)	83.35	Very good
Pedagogical Content Knowledge (PCK)	82.43	Very good
Technological Content Knowledge (TCK)	80.27	Good
Technological Pedagical Knowledge (TPK)	81.98	Very good
Technological Pedagogical and Content Knowlegde (TPACK)	78.42	Good

From Table 2. it can be seen that the highest percentage of the TPACK component is PK 83.35%, meaning that respondents have very good knowledge regarding teaching methods, how to condition the class and understand the characteristics of students. As for the other components, respectively, namely PCK 82.43%, TPK 81.98%, CK 80.98%, TCK 80.27%, TPACK 78.42% and TK 76.84%. The lowest percentage gain when compared to the other components is the TK component. This is in accordance with the results of research by Nofiani and Julianto (2018), that activities are needed that are able to increase the knowledge of teachers and prospective teachers about various software and media that support the learning process.

The use of technology in learning affects what is taught and when a learning material appears in the curriculum (NCTM, 2000 in Suyamto et al., 2020). Chai et al. (2013) explained that the integration of ICT into the

curriculum must involve the three basic dimensions of TPACK, namely TK, PK, and CK. If teachers are able to design integrated TPACK lessons, learning for students can be improved. Thus, it becomes very important to continuously improve the understanding of the T component of TPACK (Sukaesih, et al., 2017).

Content Knowledge (CK).

The data from the analysis of content knowledge competence for biology teachers in Aceh Province obtained the results of 80.98% (Table 2) in the very good category. These results indicate that respondents already have the ability to master the material taught to students well. The value of each item in the content knowledge section for all teachers can be seen clearly in Table 3.

Table 3. Value of Item Content Knowledge (CK)

Item Content Knowledge (CK)	Mean
I can use mathematical thinking	3.93
I can use historical thinking	3.90
I have sufficient knowledge of biology	4.19
I can use scientific thinking	4.32
I have a variety of ways and strategies to develop my understanding of biology	4.18
I have sufficient knowledge about literacy	3.99
I can use literate thinking	3.94
I have various ways and strategies to develop my understanding of literacy	3.94

From Table 3. it can be seen that the highest mean value is in the scientific way of thinking (4.32), while the historical way of thinking is the lowest (3.90). Overall, the mastery of content knowledge for biology teachers is in the very good category (Table 2).

Teacher content knowledge which includes an understanding of theories, concepts, facts, and procedures in the field of knowledge determines the unique way of thinking of teachers. Nofiani and Julianto (2018) state that teachers who master the teaching material certainly master the body of knowledge being taught; can sort the anatomy of teaching materials, including identifying weaknesses and strengths, as well as the easiest and most difficult parts. Based on the content knowledge item, the teacher has appropriate content knowledge to be taught to students.

Teachers are expected to master content knowledge, because it has a positive impact on students. Harlen and Holroyd (1997) explain that a teacher's content knowledge has a positive influence on decision making related to changing teaching strategies. A teacher who has good content knowledge will be able to simultaneously construct material elements in working memory, paying attention to the initial abilities of students by giving directions, the material is not delivered at once or considering prerequisite knowledge (Rahmadhani et al., 2016).

Technological Knowledge (TK)

The data from the analysis of the competence of knowledge of technology in biology teachers in Aceh Province obtained the results of 76.84% (Table 2) in the good category. These results indicate that the respondents already have the ability to master the technology that is taught to students well. The value of each item in the technology knowledge section for all teachers can be seen clearly in Table 4.

Table 4. Value of Technological Knowledge (TK) Items

Item Technological Knowledge (TK)	Mean
I know how to solve tech device problems myself	3.64
I can learn technology easily	3.92
I keep up with important new technology developments	4.18
I am used to technology	4.03
I know about several different technologies	3.81
I have the technical skills needed to use technology	3.63
I have enough opportunities to work with different technologies	3.69

From Table 4. it can be seen that the highest mean value is found in following important new technology developments (4.18), while the technical skills required to use technology are the lowest (3.63). Overall mastery of knowledge of technology in biology teachers is included in the good category (Table 2).

Technological knowledge is an understanding of how to use technology for learning, the ability to continue to learn and find out about the latest technologies that can be used in learning. Knowledge of technology is very important in learning considering that technology continues to develop. Mishra and Koehler (2006) mention that technology continues to develop, knowledge about technology continues to change from time to time. Therefore, the ability to learn and adapt to new technologies is very important.

Teachers' knowledge of technology makes it easier for students to understand learning methods. Rahayu (2017) explains that teachers need good knowledge of certain technological abilities to assist students in learning certain topics or skills with the help of technology. Jamieson-Proctor et al. (2010) also mention technology knowledge not only refers to the instrumental skills needed to operate a technology but also knowledge about the ability of technology to achieve personal and professional goals.

Pedagogical Knowledge (PK)

The data from the analysis of the pedagogical knowledge competence of biology teachers in Aceh Province was found to be 83.35% (Table 2) in the very good category. These results indicate that the respondents already have the ability to master the pedagogical knowledge that is taught to students well.

The value of each item in the pedagogical knowledge section for all teachers can be seen clearly in Table 5.

Tabel 5. Nilai Item Pedagogical Knowledge (PK)

Item Pedagogical Knowledge (PK)	Mean
I know how to assess student performance in class	4.40
I can adapt my teaching based on what students understand	4.27
I can adapt my teaching based on what students don't understand	4.17
I can adapt my teaching style for students with different abilities	4.17
I can assess student learning in various ways	4.17
I can use a variety of teaching approaches in a classroom setting	4.18
I am used to the general understanding and misconceptions of students	3.77
I know how to organize and maintain class management	4.22

From Table 5, it can be seen that the highest mean value is in the knowledge of assessing student performance in class (4.40), while the lowest (3.77) is related to the general understanding and misconceptions of students. Overall mastery of pedagogical knowledge of biology teachers is included in the very good category (Table 2).

Pedagogical knowledge is a skill that must be developed by teachers in order to be able to manage and organize teaching and learning activities. Government Regulation of the Republic of Indonesia No. 19 of 2005 explains that pedagogical competence is the ability of teachers to manage learning which consists of understanding students, planning, evaluating learning outcomes, and actualizing all the potential of students. Sintawati and Indriani (2019) explained that pedagogical knowledge also includes the ability to adapt and learn the latest learning methods or create learning strategies according to class needs.

Teachers who master pedagogical knowledge are able to organize student activities in class. Rahayu (2017) explains that teachers who have good pedagogical knowledge will understand how students build knowledge and acquire skills, as well as how students develop habits of mind and positive learning attitudes. For this reason, teachers need knowledge of cognitive and social learning theory and the theory of student development. As an illustration, teachers can distinguish various learning strategies.

Pedagogical Content Knowledge (PCK)

Data from the analysis of pedagogical content knowledge competencies for biology teachers in Aceh Province, results were 82.43% (Table 2) in the very good category. These results indicate that the respondents already have the ability to master the pedagogy that applies to the content taught to students well. The value of each item in the pedagogical content knowledge section for all teachers can be seen clearly in Table 6.

Table 6. Value of Pedagogical Content Knowledge (PCK) items

Pedagogical Content Knowledge (PCK)	Mean
I can choose an effective teaching approach to guide students' thinking and learning processes in literacy	4.05
I can choose an effective teaching approach to guide students' thinking and learning processes in biology	4.19

From Table 6. it can be seen that the highest mean value is found in the knowledge of choosing an effective teaching approach to guide students' thinking and learning processes in literacy (4.19), while knowledge of choosing an effective teaching approach to guide students' thinking and learning processes in biology is the lowest value (4.05). Overall, the mastery of pedagogical content knowledge for biology teachers is in the very good category (Table 2).

Knowledge of pedagogical content is the teacher's ability to convey material to students. Teachers integrate content and pedagogy into an understanding of how certain aspects of the material are structured and adapted to teaching (Nissa, 2018). Sukaesih et al. (2017) mentions that apart from knowing the material/teaching materials to be taught, a teacher must understand and be able to integrate content knowledge into knowledge about curriculum, learning, teaching and especially students. These knowledges can ultimately lead teachers to arrange learning situations according to the needs of individual and group students.

Knowledge of pedagogical content is as important as knowledge of the subject matter that is the subject of the learning process. Nissa (2018) explains that without knowledge of pedagogical content, the transformation of subject matter in an effort to build students' knowledge will not go well. Knowledge of pedagogical content is also a major component in teaching to produce quality teachers, so as to improve the teaching and learning process which aims to provide a better understanding of students.

Technological Content Knowledge (TCK)

The data from the analysis of the content technology knowledge competence of biology teachers in Aceh Province obtained the results of 80.27% (Table 2) in the good category. These results indicate that respondents already have the ability to master technology on certain materials that are taught to students well. The value of each item in the content technology knowledge section for all teachers can be seen clearly in Table 7.

Table 7. Value of Technological Content Knowledge (TCK) items

Technological Content Knowledge (TCK)	Mean
I know about technology that can be used to understand and teach literacy	3.89
I know about technology that can be used to understand and teach biology	4.14

From Table 7. it can be seen that the highest mean value is found in the knowledge of technology that can be used to understand and teach biology (4.14), while the technology that can be used to understand and teach literacy is the lowest value (3.89). Overall, the mastery of content technology knowledge for biology teachers is in a good category (Table 2).

Understanding the benefits of technology helps teachers make strategic decisions about technology integration. Technology has an impact on teachers in describing content (material) in different ways that previously could not be done. Swan and Hofer (2011) explain that TCK items in TPACK are proven to be able to help teachers understand how to plan and implement learning by integrating technology in the classroom.

Understanding content technology knowledge can produce new representations of specific content. Cox (2008) explains that TCK is not only an understanding of how technology can be used to describe content but also how technology can change or even produce content. This statement means that technology can open or explain content that was previously not clearly understood so that it becomes easy to understand and clear.

Technological Pedagical Knowledge (TPK)

Data from the analysis of competence in pedagogical technology knowledge for biology teachers in Aceh Province, the results were 81.98% (Table 2) in the very good category. These results indicate that respondents already have the ability to master technology that is able to change the way students teach well. The value of each item in the pedagogical technology knowledge section for all teachers can be seen clearly in Table 8.

Table 8. Value of Technological Pedagogical Knowledge (TPK) Items

Item Technological Pedagical Knowledge (TPK)	Mean
I can choose technology that can improve my teaching approach in a lesson	4.06
I can choose technology that can improve student learning in a lesson	4.06
My teacher education program has made me think more deeply about how technology can affect the teaching approach I use in the classroom	4.22
I think critically about how to use technology in class	4.12
I can adapt the use of the technology I learn to various teaching activities	4.03

From Table 8. it can be seen that the highest mean value is found in the results of the teacher education program that has been taken to make thinking more deeply about how technology can affect the teaching approach used in the classroom (4.22), while adjusting the use of technology learned for various teaching activities is the lowest value. (4.03). Overall, the mastery of pedagogical technology knowledge in biology teachers is in the very good category (Table 2).

Knowledge of technology pedagogy is an understanding of how various technologies can be used in teaching and the use of technology can change the way a teacher teaches. Cox (2008) mentions that the use of technology as part of a pedagogical strategy and how technology and pedagogy interact. Teachers' pedagogical technology knowledge can influence and improve learning strategies and outcomes. Suyamto et al. (2020) also explained that technology can provide new methods used in the teaching process and can make it easier to apply in learning. For example, online learning system learning caused by the development and needs of the community requires teachers and instructors to be more innovative and creative.

Technological Pedagogical and Content Knowlegde (TPACK)

The data from the TPACK competency analysis for biology teachers in Aceh Province obtained the results of 78.42% (table 2) in the good category. These results indicate that the respondents already have the ability to integrate material, presentation and use of technology well to students. The value of each item in the TPACK section for all teachers can be seen clearly in Table 9.

Table 9. Value of Technological Pedagogical and Content Knowledge Items (TPACK)

Item Technological Pedagogical and Content Knowlegde (TPACK)	Mean
I can teach lessons that appropriately integrate literacy, technology and teaching approaches	3.85
I can teach lessons that properly integrate biology, technology and teaching approaches	3.98
I can choose the technology used in class to improve the material I teach, the way I teach, and the material students learn	4.09
I can use strategies that integrate the content, technology, and teaching approaches I learn in the classroom	3.86
I can take the lead in helping others to coordinate the use of content, technology and teaching approaches at school and/or in my area	3.72
I can choose technology that can improve the content for the lesson	4.02

From Table 9. it can be seen that the highest mean value is in the knowledge of choosing the technology used in the classroom to improve the material being

taught, teaching methods, and the material learned by students (4.09), while taking the lead in helping others to coordinate the use of content, technology, and the teaching approach in my school and/or area is the lowest score (3.72). Overall, the mastery of content knowledge for biology teachers is in the very good category (Table 2).

TPACK which is a combination of three knowledges, namely content, pedagogy and technology including integrating (choosing, using and combining) technology appropriately in learning strategies for certain content has an influence on the learning process. This is in line with Rosyid's (2016) explanation that the TPACK framework has a significant impact on teachers and teacher educators. The TPACK framework also functions as a theory and concept in measuring the readiness of prospective teachers or teachers in effective learning with complex interactions between domains of knowledge principles (content, pedagogy, technology).

The teacher's TPACK profile is important because it can be used as an initial description of the teacher's abilities in the fields of content, pedagogy, and technology. Mishra and Koehler (2006) state that teachers must have an understanding of the complex interactions between the basic components, namely content, pedagogy, and technology by teaching materials using appropriate pedagogical and technological methods. Based on this explanation, information related to the teacher's TPACK profile is needed to be used as material for evaluating future improvements.

TPACK Biology Teacher Competence Based on Certification

Data from the analysis of the TPACK ability of biology teachers in terms of certification status, namely non-certification and certification. The results of the independent sample t-Test analysis of the TPACK competence of biology teachers based on certification status can be presented in Table 10.

Table 10. Results of Independent Sample t-Test of Biology Teacher TPACK Ability Based on Certification Status

Certification status	Mean	SD	t-Test	
			t(df)	Sig.
Certification	4.00	0.65	0.52	0.60
No Certification	4.04	0.50		

Based on the results of the independent sample t test analysis of the certification status, it was found that t (230) = 0.52, p > 0.05, this indicates that there is no significant difference in the competence of the Aceh Province biology teacher's TPACK based on certification status. This is in accordance with the opinion of Wulansari et al. (2019), namely there is no significant difference in teacher TPACK competencies based on certification.

Teacher certification is an effort to improve the quality of teachers so that the learning process becomes more qualified. Teachers who have gone through the certification program mean that they have taken the competency exam and have met the teacher's professional standards. Sujatma (2016) stated that basically teacher certification aims to improve the quality of education. In line with the statement of Pradana et al. (2019) teacher certification is closely related to professional teachers, where teacher professionalism can be seen from a number of competencies they have. It is known that this is not in accordance with the competence of the TPACK teacher certification obtained. In accordance with the statement of Pradana et al. (2019), namely that there is no significant difference between certified and uncertified teachers, is clearly a problem. Teachers who get a certification degree are expected to have good competence in the world of teaching so that the objectives of certification are achieved.

The implementation of teacher certification should be able to trigger teachers to work more optimally. Mutaqin (2008) explained that in order to achieve the main goal of teacher certification, efforts to improve the implementation of certification tests and teacher competency improvement must be carried out in a good, planned, sustainable and synergistic way. Pradana et al. (2019) also mention that regardless of the form of the program to improve the quality of teachers and education, follow-up evaluation is very necessary for maintaining the sustainability of the program.

Continuous evaluation of teacher certification needs to be carried out to maintain teacher quality. Utami (2015) mentions that certification status should not last forever as is currently the case in Indonesia, but must have an expiration date. When the certification status reaches the deadline, it is necessary to renew it by retesting. It aims to get quality teachers who are professional in their field.

Based on this explanation, it is in line with the Law of the Republic of Indonesia Number 14 of 2005 concerning Lecturers and Teachers, which states that certification is the process of providing educator certificates for lecturers and teachers. In this case, the professionalism of a teacher cannot be measured by the certification obtained, because teachers with non-certified status can also apply TPACK in learning. As explained by Joope et al. (2012) in Suyamto et al. (2020) stated that teacher certification did not show a real impact on educational outcomes even though it had spent quite a large amount of money. Based on this description, in order to maintain the quality of teacher competency certification, it is necessary to evaluate the certification program.

TPACK Biology Teacher Competencies Based on Teaching Experience

The data from the analysis of the TPACK ability of biology teachers in terms of teaching experience are beginners (0-3 years), transitional (4-5 years) and experienced (5 years and above). The results of the analysis of variance (ANAVA) on the TPACK competence of biology teachers based on teaching experience can be presented in Table 11.

Table 11. Results of Variant Analysis of Biology Teachers' TPACK Ability Based on Teaching Experience

Teaching experience	Mean	SD	ANOVA	
			F(df)	Sig.
Beginner (0-3 years)	3.98	0.52		
Transition (4-5 years)	4.23	0.52	1.83	0.67
Experienced (+5 years)	4.00	0.59		

Based on the results of the analysis of variance (anava) it was obtained that F (2, 229) = 1.83, p > 0.05, this indicates that there is no significant difference in the competence of the Aceh Province biology teacher's TPACK based on teaching experience. Likewise with the statements of Hosseini and Kamal (2013) and Wulansari et al. (2019), namely teaching experience does not have a statistically significant impact on TPACK competence. This is different from the statement of Rakib et al. (2016) which states that the longer or more teacher teaching experience, the higher the professionalism.

Teaching experience with professional values that are expected to make teachers good in teaching. However, Sahari (2015) explains that teaching experience has a different meaning from the length of teaching, so it is not necessarily a teacher who has been teaching for a long time, his teaching professionalism is also good. Lestari (2015) mentions that teaching experience is not directly proportional to the increase in TPACK abilities. This is influenced by many factors, including the busy schedule of senior teachers, causing senior teachers to not be able to take the time to learn new things, especially technological advances in supporting the teaching process in the classroom. Therefore, most senior teachers still apply conventional learning methods. In addition, Tezci (2010) states that novice teachers with less experience than experienced teachers are open to new technologies and grow with technology.

Teaching experience can not be measured by the length of teaching but from the effectiveness and assessment during the teaching process. Hoz and Tomer (1990) mention that the length of teaching experience does not affect the knowledge of subject matter and teacher pedagogical knowledge. The results of research Graham, et al. (2020) also show novice teachers (0-3 years) perform well or better than teachers with years of experience.

Conclusion

The criteria for the competence of biology teachers in Aceh Province are very good PK, very good PCK, very good TPK, very good CK, good TCK, good TPACK and good kindergarten. There is no significant difference in the TPACK competence of biology teachers based on certification and teaching experience with p>0.05.

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