TPACK perception analysis of teachers in facing 21st-century learning

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ARTICLE INFO	ABSTRACT
	This study aims to analyze and identify teachers 'perceptions of TPACK that can influence teachers' knowledge and understanding of 21st century learning. The research method used in this research is survey method with cross sectional research design. The research subjects consisted of 25 biology teachers with different teaching experiences ranging from learning experience ages less than 5 years to more than 15. The results showed that biology teachers with TPACK perceptions were quite good. Teachers 'perceptions of 21st century learning are constrained by aspects of understanding students' abilities on indicators of creativity and critical thinking. The consideration of teaching according to the skills demands of the 21st century is quite good. Teachers with low teaching experience still have less understanding of the latest learning technology. Each range of teacher teaching experiences has different abilities and perceptions and considerations of 21st century learning that can become the foundation of teachers in implementing learning in the 21st century that puts forward the 4Cs aspect.

Introduction

The teacher is a subject of learning who has a complex role that is not only a process of conveying information but includes all activities and actions that must be taken to students (Rahmadhani et al., 2016). In an era like today, namely the 21st century learning era, biology teachers are required to have professional performance and attitude in carrying out various sub-competencies such as pedagogic, social, personality, and professional realities in the school environment (Nurhayati B., 2006).

Teacher professionalism can be shown by several indicators that must have at least eight aspects including a) understanding of educational insights and foundations, b) understanding of students, c) curriculum or syllabus development, d) learning design, e) teaching and learning implementation. dialogical, f) utilization of learning technology, g) evaluation of learning outcomes, and h) developing students to actualize their various potentials (Mulyasa, 2009). In the era of technological development and globalization as it is today, learning design is combined with understanding the use of learning technology, so teachers are required to master various competencies in the developing field of learning (Nasution et al., 2017).

The indicators of professionalism that have been put forward are summarized in the ability of teachers called PCK. PCK or Pedagogical and Content Knowledge is an approach to measuring teacher abilities that require students' roles in managing the knowledge provided during learning because PCK helps teachers to create a more constructive learning atmosphere and provides opportunities for students to learn science through an inquiry approach (Chapoo et al., 2014). As time goes by, with the demands of globalization and the rapid development of information and communication technology teachers must not only have good PCK skills but also must provide subject matter that is combined with appropriate technology for current learning developments. The integration of technology in every learning is known as Technological, Pedagogical, and Content Knowledge (TPACK).

TPACK is a combination consisting of three important aspects, namely pedagogical knowledge, content knowledge, and the integration of technology used by teachers in the learning process (Mishra & Koehler, 2006). TPACK framework is a derivative of the construction adopted from Shulman (1987) which is rooted in Pedagogical Content Knowledge (PCK) by incorporating technological knowledge that is placed together with pedagogical knowledge and content knowledge. PCK itself is a wedge between pedagogical knowledge and content knowledge so that in addition to teachers being able to master content well and deeply, teachers are also obliged to direct students to have interest and motivation in learning and this is given by the teacher (Kartal et al., 2012; Shulman, 1987).

In its development, it has now entered the era of 21st-century learning. TPACK, which combines four important components, namely technology, content, pedagogy, and teacher knowledge, has a very essential role in the learning process carried out. The 21st-century era according to NCREL and Metiri Group (2003) identifies four main domains consisting of digital literacy, inventive thinking, effective communication, and high productivity. The four domains that have been described are domains that absolutely must be mastered by students as student outputs in having competence in a field. These competencies are compiled by Zubaidah (2016) into seven competencies that must be possessed by students which are emphasized by 21st-century skills which consist of: 1) critical thinking and problem-solving skills, 2) collaboration and leadership, 3) dexterity and adaptability, 4) initiative and entrepreneurial spirit, 5) able to communicate effectively both orally and in writing, 6) able to access and analyze information and, 7) have curiosity and imagination. The seven 21st century skill competencies are needed by students because in the 21st-century students compete without borders both regionally and internationally until the explosion of information and communication technology (ICT) cannot be contained because the rapid development of technology will result in the expansion of knowledge which will have an impact on the implementation of the education system (Turiman et al., 2012). The seven competencies are then summarized into four main competencies which are included in learning and innovation skills which are mapped by P21 (2007) into four competencies consisting of creativity and innovation, critical thinking and problem solving, communication, and collaboration.

Before implementing learning centered on the TPACK framework to accommodate 21st-century skills, it is important to know the teacher's view of integrated learning both in terms of technological knowledge, material content, and pedagogics as well as the extent to which teachers know the latest learning developments, especially learning in the 21st-century era. and the teacher's prior knowledge can be categorized as the teacher's perception in viewing 21st-century learning which is used as the teacher's initial knowledge. Perception is an individual's response or opinion in receiving and knowing something through the human senses (Maba, 2017). Teachers' perceptions about the implementation of 21st-century learning make it possible to generate different opinions from one teacher to another because basically the perceptions possessed by teachers are responses from professional educators who are experienced in teaching, guiding, training, educating, assessing, and evaluating students who are influenced by beliefs and feelings of educators (Maba, 2017). Teachers' perceptions and beliefs about 21st-century learning are considered very important because, at the time of

educational reform as it is today, teachers are needed to measure between ideal learning and teaching practices applied by teachers at this time.

Method

This study uses a survey method intending to see the results of teacher perceptions and knowledge related to TPACK and 21st-century learning. Data collection uses a questionnaire instrument with numerical value items and is open-ended. The survey research used in this study is the items in the instrument related to the teaching abilities that have been owned by the teacher based on the teaching experience with the teacher's view of the aspects contained in the TPACK and its relation to the teacher's knowledge of the '4Cs' component of 21st-century skills competence as well as the implementation of the use of technology that has been implemented in each learning process. The research instrument used is a modified result of the 21st-century skills teaching questionnaire compiled by Riandi et al. (2018), and the questionnaire about teacher's consideration in 21st-century teaching, which the researcher compiled by having passed the validity of the instrument test of several experts. The survey research design used is a cross-sectional design, which looks at the choices of respondents who represent a huge population and collects the focus of attention on questions at a time (Adiyanta, 2019). The data analysis technique applied in this research is by doing a percentage score of all the answers given by each research sample and divided into four major aspects of 21st-century skills consisting of creative and innovation, critical thinking, collaboration, and communication so that it looks teachers' teaching considerations must also accommodate aspects of choosing learning strategies, form assignments, assessment strategies and guiding students in 21st-century learning.

Results and Discussion

The TPACK analysis to learning in the 21st century is the result of respondents' responses which are the teacher's point of view on the TPACK ability in each teacher and is associated with the extent to which teachers perceive the importance of learning in the 21st century as well as the learning considerations that teachers provide for the achievement of 21st-century learning.

Teacher's TPACK perception

The TPACK component analysis, which is an exploratory analysis, consists of five statement components that must be answered by the teacher in the form of Strongly disagree, Do not agree, Doubtful, Agree, and Strongly agree answers. The TPACK statement consists of 31 statements which are summarized into seven TPACK components consisting of Content Knowledge, Pedagogical Content Knowledge, Pedagogical Knowledge, Technological Pedagogical Content Knowledge, Technological Pedagogical Knowledge, and Technological Knowledge. The following Table 1 shows the results of the percentage of teachers' TPACK perceptions according to the teacher's knowledge of teaching abilities in the classroom.

Teachers' perceptions of TPACK consist of seven aspects which are differentiation from the TPACK framework developed by Mulhall et al. (2003) which consists of Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Pedagogical Knowledge (PK), Technological Pedagogical Content Knowledge (TPCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Knowledge (TK). The seven aspects of TPACK were then measured into the teacher's perception of the ideal learning of biology. The questions asked consisted of 31 questions. The majority of teachers have a fairly good view of the proposed TPACK framework.

Overall, teachers have answers with the largest percentage of answers agreeing and having doubts about some of the statements put forward. In the aspect of Content Knowledge, namely in statement number three, it is stated that the teacher has high enough confidence that all the material that will be given to students can be deepened by the teacher only by studying alone. This is because the majority of the answers are found in teachers with a range of teaching experience of more than 10 years.

Table 1. Perception of biology teacher TPACK

TPACK Aspect	Statement	Statement Percentage				
		Strongly disagree	Do not agree	Doubtful	Agree	Strongly agree
CK	1	0	0	0	75	25
	2	0	0	0	75	25
	3	0	0	0	87.5	12.5
	4	0	0	0	75	25
PCK	1	0	0	25	75	0
	2	0	12.5	37.5	37.5	12.5
	3	0	0	25	62.5	12.5
	4	0	12.5	25	50	12.5
	5	0	12.5	12.5	62.5	12.5
PK	1	0	0	12.5	75	12.5
	2	0	0	12.5	75	12.5
	3	0	0	12.5	75	12.5
	4	0	0	12.5	75	12.5
	5	0	0	12.5	75	12.5
TPCK	1	0	0	12.5	62.5	25
	2	0	0	37.5	62.5	0
	3	0	0	25	75	0
	4	0	0	50	50	0
	5	0	0	37.5	62.5	0
TCK	1	0	0	25	62.5	12.5
	2	0	12.5	25	62.5	0
	3	0	0	12.5	87.5	0
	4	0	0	12.5	87.5	0
TPK	1	0	12.5	12.5	75	0
	2	0	12.5	0	75	12.5
	3	0	12.5	37.5	50	0
	4	0	12.5	37.5	50	0
TK	1	0	12.5	12.5	62.5	12.5
	2	0	0	12.5	87.5	0
	3	0	0	37.5	62.5	0
	4	0	0	37.5	62.5	0
Average of Statement Percentage		0	12.50	23.56	68.15	15.44

In line with the statement Kind (2014) that the teacher's experience related to science/biology can greatly affect the teacher's confidence in the teaching subject that will be delivered by the teacher in the classroom. Increasing references is the main reason teachers have confidence in these components. In addition to statement number three on the content knowledge aspect, the highest score percentage was also obtained in the statement that teachers can use appropriate technology to represent the content of the material to be taught, can use special software to conduct investigations related to learning tools, and that teachers at this time can learn technology easily. From the results of these perceptions, it is known that the majority of teachers have confidence in using and implementing technology in learning, because almost 65% of teachers are young teachers with a span of 5-10 years of a learning experience, in addition to the relatively young age range of teachers' attitudes towards development. ICT in education is the key to teacher understanding of developing the technology because it is identified that teacher attitudes do not always show positive things that cause teacher failure to understand today's learning technology developments (Raja & Nagasubramani, 2018).

Smerdon et al. (2000) report that the development of young teachers with a relatively short range of teaching experience becomes quite confident in the technology used because young teachers develop and grow with technology (computers) so that they can help change the teaching practices of these teachers. Tsai (2015) explains that there are four categories of teacher use of technology that are generally mastered, namely: 1) use of technology in conducting evaluations, 2) use of technology in delivering material, 3) use of e-mail, 4) use of technology by teachers as teaching preparation materials and 5) teacher-directed use of student technology (Russell et al., 2003). The use of computer-assisted technology, especially during classroom learning, positively affects students' academic achievement.

Within the 21st-century learning framework ICT literacy (Information, Communication, and Technology) has a very essential role in achieving the 21st-century learning process. The ability that must be improved concerning the use of technology in the teacher's view is that the use of technology must be under the content of the material presented. will be given to students so that the use of technology will be very detailed when it is associated with biology learning materials.

Teacher's perception of 21st century learning

Teachers' perceptions of 21st-century learning were identified to see teachers' views on 21st-century learning. Classification of teachers' perceptions of 21st-century learning is divided into four major aspects consisting of creativity & innovation, critical thinking & problem solving, communication, and collaboration. The Table 2 is a description of the teacher's TPACK divided according to the time of the learning experience that has been taken which can at least influence the teacher's views and perceptions of 21st-century learning.

Based on Table 2 the percentage results of the survey, it is known that the smallest percentage score is in the aspects of creativity and critical thinking with the age range of teachers under 5 years to 15 years of teaching. This can be identified from several questions posed to teachers related to these two aspects, such as aspects of evaluating creativity and critical thinking and teacher difficulties in identifying curriculum (basic competencies) which require teachers to further deepen learning design in aspects of creativity and critical thinking in learning. 21st century. The aspect of critical thinking is an aspect that has a relatively low average score. One of the things that can be identified is that the critical thinking ability assessment factor is the main cause of the teacher's low score on this aspect. This is explained by Redecker et al. (2011) that critical thinking skills include abilities possessed by individuals that must be observed in depth such as the ability to access, analyze, synthesize information, interpret and evaluate information evidence. The implementation will take a relatively long

time by looking at the number of students in the class. In addition, the aspects of creativity and innovation also obtained a low average score caused by several factors starting from the limited learning planning process carried out by the teacher. Creative learning can be started by triggering students to think outside their existing habits, involving new ways of thinking, conveying new ideas and solutions, and asking unusual questions (Zubaidah, 2016). One strategy that can be applied in developing learning that can increase creativity is the use of social media by teachers and students. The use of social media can support creative and innovative pedagogical strategies by encouraging learning processes that are based on personalization, collaboration, and changes in interaction patterns between students and teachers (Redecker et al., 2011).

21st-Century teaching considerations

There are five aspects of teacher considerations in conducting 21st-century learning that is under the Technological Pedagogical and Content Knowledge (TPACK) framework. The five aspects consist of 30 questions which are grouped into, 1) learning strategies, 2) the form of assignments given, 3) the use of assessment strategies, 4) guiding students in achieving 21st-century learning and 5) the use of technology and students' social media (Figure 1). The five aspects are calculated based on a questionnaire given to the teacher as a representation of the teacher in considering 21st-century learning which includes the planning, implementation, and evaluation process of learning. The results of the questionnaire are then presented on a graph of 21st-century learning considerations (Figure 1).

Consideration of learning becomes very important because it is closely related to the initial process, namely planning, the learning process to teacher evaluation. Hidayah et al. (2017) explained that the consideration of learning means that the teacher gives appreciation to each student so that students fully feel that they are given equal rewards and opportunities in every learning process carried out. In full, the teacher's statement on the importance of considering aspects of 21 st-century learning is presented on the Figure 1.

Table 2. Teacher's perception of 21st century learning

No	Teaching experience (Year)	Teacher's perception of 21st-century learning indicators (%)				
		Creativity and innovation	Critical thinking and problem solving	Communication	Collaboration	Average of percentage
1	Under 5	65	50	75	75	66.25
2	5-10	65	60	75	75	68.75
3	10-15	75	50	80	75	70
4	More than 15	70	75	85	75	76.25

The consideration factors for 21st-century learning are then summarized into five major aspects which are a summary of 30 questions given to teachers with an age range ranging from teachers with less than five years of teaching experience to teachers with more than 15 years of teaching experience. Of the four criteria, teachers according to the time of teaching experience have fluctuating scores.

The first aspect that is calculated is the teacher's representation in developing learning strategies. Teachers with long teaching experience, namely at least having teaching experience of more than 10 years, have higher teaching experience considerations compared to teachers who have a lower range of teaching experience. The experience of the teacher will greatly affect the use of learning strategies because according to Aini and Sudira (2015) the experience of teachers in the learning process affects the learning strategies used. While the experience of students will shape individual learning styles, as taught how to learn.

The second aspect is the form of the task that the teacher gives to the students. The variety of tasks given by the teacher will have a very important impact on students' knowledge and skills, assignments can build and hone what students look like in solving a problem. Teachers with an age range of under five years and teachers with a teaching period of 10-15 years have the perception and consideration of the tasks that must be given to students. The varied forms of assignments become the benchmark for teachers in developing projects that must be completed by the main students, namely in learning biology.

The use of assessment strategies is very important for teachers to use in evaluating learning. The TPACK framework instructs teachers to implement various assessment strategies by the learning indicators listed in the basic competencies of a material topic. Teachers with teaching spans of more than 15 years tend to use conventional assessment strategies by recapitulating scores on the cognitive and skill aspects of students but tend to neglect to assess aspects of student attitudes. Teachers focus on aspects of cognitive assessment with various evaluation techniques used such as written tests and quizzes but tend to have not explored the psychomotor and attitude aspects of students. According to Shing et al. (2015), evaluation techniques that can be used by teachers consist of various kinds such as assessing individual or group performance results, written reports, quizzes, or other tests. Teachers with teaching experience above 15 years tend to only focus on one type of assessment. According to van Driel and Berry (2012), teachers with longer teaching experience tend to have less professional development, thus limiting knowledge of the latest assessment techniques to be applied to students. Assessments that do not involve electronic or computer components are also the focus of attention, that in general the longer the teacher's experience in teaching the teacher tends to ignore the importance of electronic-based assessment which is usually more widely used in the 21st century learning period as it is today, because according to Riandi (2015) the use of electronic devices or ICT in the context of teaching and learning should be able to produce interactions between teachers and students or between students in study groups.

The 21st-century learning process which is more focused on four indicators of 21st-century competence achievement, namely communication, collaboration, creative & innovative thinking as well as critical thinking and problem-solving becomes a benchmark for teacher consideration in the assessment.
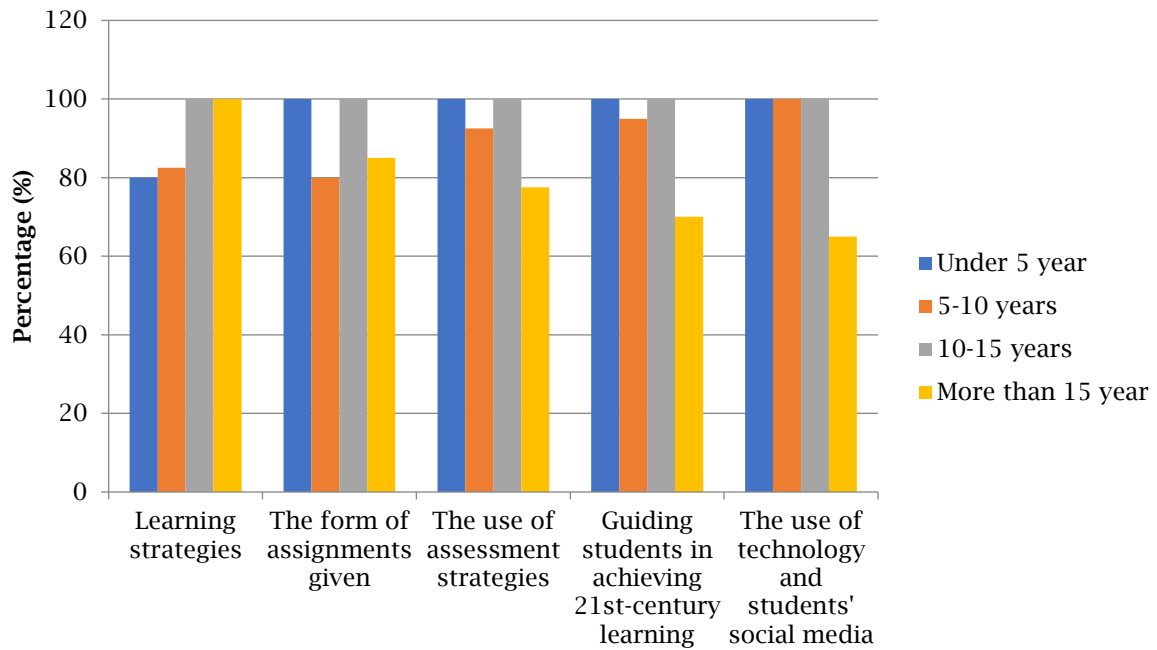
Figure 1. 21st-Century learning considerations

In general, teachers spontaneously and confidently carry out the learning process, especially in aspects of communication and collaboration in the learning process from design, implementation to learning evaluation. Things that can be observed from the aspect of 21st-century learning guidance, namely, teachers still find it difficult to develop indicators of critical thinking learning and learning innovation, especially in the aspect of learning evaluation. The factors that cause these difficulties include the process of critical thinking skills which, according to the teacher must be carried out on each individual and carried out in-depth. The critical thinking skills include abilities possessed by individuals that must be observed in depth such as the ability to access, analyze, and synthesize information, interpreting and evaluating information evidence (Redecker et al., 2011; The Partnership for 21st century skills, 2008; Zubaidah et al., 2017). The teacher's relatively minimal knowledge in terms of using and developing assessment instruments and rubrics on these two aspects is one of the causes of the lack of teachers being able to develop these two aspects.

The 21st-century learning framework which in addition to focusing on achieving 21st-century learning competencies requires teachers to be able to use ICT components in the learning process that will be implemented. This is stated in the learning framework with the term ICT literacy. Based on Figure 1 that can be seen, that teachers with a range of teaching experience under 15 years are still able to adapt and use technology to support the learning process in the 21st century, this can be caused by several things, including regular workshop programs that are attended by teachers with age ranges. However, for teachers with an age range of teaching experience above 15 years, teachers tend to be passive in terms of adapting to learning technology so that teachers tend to find it difficult to implement and integrate technology in every topic of biology material that will be delivered.

Conclusion

Some conclusions from the results of teachers' understanding and perception of 21st-century learning are: 1) Teachers' TPACK perceptions must be fully understood by teachers which consist of seven aspects that are related to one another consisting of four assessment factors, namely pedagogy, content understanding and mastery of educational technology. present time. 2) Teachers' perceptions of 21st-century learning aspects known as 4Cs have fluctuating abilities. In general, teachers still

experience difficulties in understanding the evaluation process in critical and creative thinking aspects due to the lack of experience in the workshops that are mainly related to the development of 21st-century learning. 3) The consideration of 21st-century learning should be mastered by teachers starting from the planning, implementation to learning evaluation processes. So that it can accommodate the demands of 21st-century learning.

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