

Teaching Performance of High School Biology Teachers in Applying TPACK: A Descriptive Study

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Abstract—TPACK was a knowledge that teachers need to master to teach effectively with technology. TPACK needs to be applied in the learning process to realize technology integrated learning. The implementation of TPACK in the learning process can be reflected in teacher teaching performance. This research aims to determine the performance of biological teachers in applying TPACK to the learning process. This research is a survey study with observation methods. The study involved 68 respondents of biology teachers who were convenience sample. Data collection is performed using an observation sheet instrument. The results of the implementation of PCK High school biology teachers in D.I.Yogyakarta province was good criteria with a score of 75.04, but the components of TPK with a score of 39.76, and TPACK with a score of 37.74 which is classified as a good criteria, while the ability Implementation of TCK which is classified as the criteria is not good with a score of 28.06.

Keywords: *TPACK, teacher, biology, technology*

I. INTRODUCTION

The integration of ICT in learning becomes a necessity in the 21st century education. This is because, one of the skills that must be mastered by the 21st century student is the skill in ICT. People in the 21st century lives in technology and a media-based environment. Consequently, the skills of information literacy, media literacy, and ICT literacy related to finding information from unlimited resources on the internet need to be owned by student. Student have been required to learn from various sources. One of them through the Internet. These skills are crucial for preparing the future of learners living in the digital World [1]. Students who do not master this skill will have difficulties in his or her life in the present and

future [2]. One way to equip the generations that will come with these life skills is through education.

The 2013 curriculum as part of the education system in Indonesia also emphasizes the integration of ICT in learning. The information and communication technology (ICT) in the 2013 curriculum is not a stand-alone subject but as an integrated learning tool on all subjects. This change gives the consequences that all teachers must master and integrate ICT into the learning process is no exception to biological subjects. Biology will always evolve because of the latest inventions and theories of biology need to be known by teachers. One of the media that can be used to access a growing range of science is the Internet. Through the Internet, information from all over the world can be obtained in a short time. Therefore, the utilization of ICT in learning especially biology becomes very important.

Characteristics of biology that are difficult to understand by students can be assisted by technology. The results showed the submission of information using ICT had a positive effect on the students ' interest in learning biology and test results were also improved on the classroom with integrated technology learning [3.4]. Therefore, the use of ICT in learning can increase interest and improve student performance. For that, integration of ICT in learning needs to be done by teachers as an effort to increase the interest in learning and achievement of students.

Teacher is an agent of change that has an important role in integrating ICT in learning. ICT Mastery is supposed to have a teacher because at the standard of the Indonesian National Qualification Framework (KKNI), teachers are already on level 7 so that it must be able to utilize science and

technology in its performance. In addition, in the Regulation of the Minister of Research, Technology and Higher Education (Permenristekdikti) number 55 year 2017 about the standards of education teachers mentioned that the achievement of learning graduate degree programs education and professional education, teachers must be able to implement information and communication technology in planning, organizing, evaluation, and management of learning, able to apply knowledge and skills in information technology in the context of scientific development and implementation of field of expertise, mastering the integration of technology, pedagogic, and scientific content [5]. Therefore, teachers are required to be able to integrate ICT in the learning process.

To be able to integrate ICT in the learning process, the mastery of pedagogic content knowledge (PCK) is not enough to be owned by the teacher, but the teacher must also master the knowledge of technology integrated with knowledge pedagogic and content. Integration of pedagogic knowledge, content, and technology in order to realize an integrated ICT learning called Technological Pedagogical and Content Knowledge (TPACK) [6].

TPACK represents a collection of knowledge that teachers need to teach effectively with technology. Good teaching with technology requires at least three components namely Pedagogical Knowledge (PK), Content Knowledge (CK), and Technological Knowledge (TK). The three interconnected form Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical and Content Knowledge (TPACK). The technology referred to in TPACK is the use of information Technology (ICT) in accordance with the proposed Committee of Information Technology Literacy of the National Research Council (NRC). In addition, several studies have been conducted to examine TPACK's relationship with teachers and students' learning achievements. Research results demonstrate the ability of TPACK teachers who are high expected to improve student performance. TPACK has a positive correlation to the learning achievements of students who are increasing TPACK teachers, and students' learning achievements will also increase [7]. Therefore, teachers need to master TPACK in order to integrate ICT in learning well.

Evaluation of TPACK implementation of learning process becomes necessary because it is likely that the evaluation has not been done by the government. The Government's periodical evaluation is the Teacher Competency Test (UKG) and teacher performance assessment (PKG) but this assessment only leads to pedagogic and professional competence or Pedagogical Content Knowledge (PCK). The assessment has not revealed the knowledge mastery

of other teachers such as TK, TCK, TPK, and TPACK. In addition, evaluation has not yet led to the teacher's ability to implement TPACK on teacher teaching performance in the learning process. Therefore, it is necessary to do a teaching performance evaluation of biology teachers in implementing TPACK in the learning process, especially in the province of D.I.Yogyakarta is one of the provinces in Indonesia which is a barometer for other regions in terms of quality of education.

II. METHOD

A. Type of Research

This type of research is research survey. The research aims to evaluate the teaching performance of teachers in implementing the TPACK in the learning process. The population of this research is all high school biology teachers in D.I.Yogyakarta. The sample in this study was a convenience sample of 68 biology teachers and came from a hypothetical population.

B. Instrument

Data collection used observation instruments. TPACK consists of 7 components namely PK, CK, TK, PCK, TCK, TPK, and TPACK. This study carried out limited measurements on PCK, TCK, TPK, and TPACK components. Measuring the basic knowledge components of PK, CK, and TK is difficult with observation techniques. The measurement of these components is more precise with test instruments. The instrument of observation sheet has fulfilled logical and empirical validity. Logical validity of the observation instruments through expert judgment while empirical valence is obtained from the correlation test result point biserial with the value R count > 0.602 meaning the whole item is valid. The reliability of observation instruments involves 4 raters with intraclass correlation coefficient (ICC) test with a value of > 0.75 in a good reliability category.

C. Data Analysis

The data is analyzed descriptively including the mean, standard deviation, maximum value, and minimal value. The observation score is converted to a value of 100, with the formula:

$$p = \frac{f}{N} \times 100$$

information:

P = value

f = score obtained

N = maximum score

The value obtained next is compared to the following criteria to know how the teaching performance of biology teachers in applying TPACK. TPACK's application mastery criteria are based on

criteria according to Arikunto [8] which can be seen in table 1.

TABLE I. CRITERIA OF TPACK

Value	Criteria
84-100	Excellent
68-83	Very good
52-67	Good
36-51	Fair
≤35	Poor

III. RESULT

This research emphasizes the ability of high school biology teachers in D.I.Yogyakarta integrates TPACK components in the learning process. For this reason, the ability to apply TPACK biology teachers is sufficiently observed from only 4 components, these components are PCK, TCK, TPK, and TPACK. The ability of high school biology teachers in D.I.Yogyakarta applies the TPACK framework in the learning process presented in table 2.

TABLE II. ABILITY OF HIGH SCHOOL BIOLOGY TEACHERS IN D.I.YOGYAKARTA IMPLEMENTING THE TPACK FRAMEWORK IN THE LEARNING PROCESS

Component	Mean	SD	Min	Max	Criteria
PCK	75.04	15.45	33.33	100.00	Good
TCK	28.06	23.10	0.00	100.00	Poor
TPK	39.76	27.81	0.00	100.00	Fair
TPACK	37.74	27.32	0.00	100.00	Fair
Mean	45.15	23.42	8.33	100.00	Fair

Descriptive analysis results show that high school biology teachers in D.I.Yogyakarta has a good ability in implementing PCK, but it is not good in applying TPK and TPACK. In the application of TCK components, the ability of biology teachers to qualify is not good. In general (includes 4 components), the ability of high school biology teachers in the D.I.Yogyakarta applies the TPACK framework in the learning process and does not qualify as 45.15. The highest ability possessed by the teacher is to apply PCK in the learning process, while the lowest ability is to apply TCK.

IV. DISCUSSION

The results of the observation of the learning process show that the ability of biology teachers to apply PCK is good. The ability of biology teachers to apply good PCK can be seen from the number of teachers who are able to: (1) choose approaches, models, and learning methods that are appropriate to the biological content being taught, (2) choose learning media that is appropriate to biological content, (3) deliver content biology is well suited to the characteristics of students so students are enthusiastic about learning, (4) creating meaningful interactions with students in conveying biological content, and (5) choosing assessment techniques that

are appropriate to biological content, including assessing cognitive, affective, and psychomotor aspects.

The ability of high school biology teachers in the D.I.Yogyakarta implemented PCK well according to the UKG results conducted in 2015. The UKG results showed that PCK teachers in D.I.Yogyakarta gets the highest score nationally with an average of 62.58 [9]. This average is above the national average minimum set of 55.00. This means high school biology teacher in D.I.Yogyakarta is able to integrate pedagogical knowledge with biological content in the learning process.

Teaching is not an easy thing, teachers must be able to convey biological content in an interesting and fun way so that students are enthusiastic in learning. Therefore, teachers must master the material of biology (content) and teaching (pedagogy). The combination of content and pedagogy creates new knowledge, namely Pedagogical Content Knowledge (PCK). PCK was able to demonstrate the quality and professionalism of a teacher. The ability to apply good PCK indicates that the teacher can orient learning, break down complexity through simple language, connect lessons with the daily activities of students and can explain with a clear material structure [10].

Teachers who master PCK will easily achieve their learning goals because they understand aspects of pedagogy and biological content. But PCK that has been mastered by the teacher must be applied in learning that can be used for effective and efficient learning. The application of PCK in the learning process is important because it can make it easier for students to understand biological content. The teacher's PCK can influence the way of learning and student learning outcomes [11, 12].

Although the ability of high school biology teachers to apply PCK is good, teachers must continue to improve their abilities in order to achieve maximum results. The ability of teachers to continue learning is the main foundation in improving the ability to implement PCK. Improving the ability to apply PCK can be done by teachers learning through peers, activities of the Subject Teachers' Consultation (MGMP), participation in workshops and education and training. Teachers must also be sensitive to educational problems in order to be able to find the right solutions to overcome them and be able to be applied in the learning process.

High school biology teachers in D.I.Yogyakarta province are not good criteria in applying TCK. This can be seen from the number of teachers who have not been able to adjust biological material with ICT. The teacher is not maximally using ICT, the use of ICT is only limited to collecting material in order to make a power point. The use of ICTs should be maximized, for example by creating learning websites

that are interesting for students. Utilization of technology to the maximum will be able to make abstract material easier for students to learn. According to [13] science (an example of biology) is a more abstract material for students so science teachers tend to use technology more when learning.

In the TPK and TPACK components, high school biology teachers in the D.I.Yogyakarta is not good at applying it to the learning process. Based on field observations, many teachers are less able to: (1) adapt ICTs to approaches, models, methods, and learning media, (2) adjust ICTs, materials, approaches, models, methods, and learning media to student characteristics. Based on observations in the field, the average teacher uses power point media and video to support the learning process. Whereas power points can be said to be old-fashioned learning media and are not in accordance with the characteristics of 21st century students who are active and like exciting new things.

The fact that the use of ICT in the learning process has not run optimally resulted in the information and knowledge obtained by students is less developed. Based on [14] revealed that ICT can help students concentrate, broaden information, get better understanding, and provide students with opportunities to work on projects with students and experts from other countries. ICT can support the learning process in obtaining true, accurate and transparent information so that Indonesian education has competitiveness with other countries [15].

Overall (includes 4 components), the ability of high school biology teachers in the D.I.Yogyakarta applies the TPACK framework in the learning process which is not good. This is unfortunate because mastering TPACK is important for biology teachers, TPACK which the teacher has will make it easier for teachers to deliver biology material to students. Teachers must master the TPACK framework so that learning activities can run effectively and efficiently [16].

The ability of high school biology teacher in applying TPACK in D.I.Yogyakarta still not maximum, this result indicates that teachers have not been able to master ICT facilities to be used as active learning. Active learning media using ICT facilities (e-learning) include quipper school, edmodo, moodle, and others that can be accessed online. Several factors can cause the low ability of teachers to apply TPACK, one of the factors is the teacher has never received training in the use of ICT in learning and teacher attitudes towards the development of ICT. The low mastery of ICT teachers is influenced by the lack of experience on how to use and adjust to ICT [17].

Based on interviews, some teachers lack understanding of ICT facilities that can support the learning process, they assume that age reduces their enthusiasm and understanding of ICT facilities. The

use of ICT in the learning process is more often done by students, the teacher only directs students to look for additional information using the internet in completing assignments.

Biology teachers' ability to implement the TPACK framework in the learning process is still unfortunate. Teachers should be able to meet the demands of the times by developing their TPACK. This has become the material of evaluation both by teachers, schools and government. The government should provide training to biology teachers on the use and integration of ICT in supporting the learning process. The government must implement a professionalism development program for teachers on an ongoing basis so that the quality of education in Indonesia improves.

V. CONCLUSION

Based on the results of the study, it was concluded that the ability to apply PCK high school biology teachers in the D.I.Yogyakarta is in good criteria, but the TPK and TPACK components are inadequate, while the ability to apply TCK is not good.

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