The TPACK Profile of Biology Teacher Based on Certification Status: A Case Study in Bantul Regency

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Abstract. This study aims to find out the differences TPACK profile of biology teacher based on certification status. TPACK is a framework that must be possessed by teachers in utilizing technology to deliver the subject matter to students. The sample used in this study was 38 biology teachers in Bantul. The selection of samples in this study used a convenience sampling technique. This study used observation techniques in data collection. The data was then analyzed descriptively and inferentially. The results of the study showed that the PCK and TCK profile is no different between certified biology teachers and un-certified biology teachers, certification status has more influence on the mastery of TPK and TPACK.

1. Introduction

The teacher is one of the important components of education system. Law number 14 of 2005 concerning teachers and lecturers states that teachers are professions that have the main task of educating, teaching, guiding, directing, training, evaluating, and evaluating students[36]. The teacher must have competence in carrying out his professional duties. Competencies possessed by the teachers influence the achievement of learning objectives. The competencies are pedagogical competence, personality competence, social competence, and professional competence, according to the mandated the law number 14 of 2005 concerning teachers and lecturers[36]. Competent teachers must have good communication skills, ability to motivate students, and good material content knowledge[19].

In case of implementing 21st-century learning, competent teachers hold significant roles. The 21st-century learning focuses on the importance of developing students’ skill in confronting the challenges of 21st-century life. The skills of 21st-century students are critical thinking, creativity, communication, and collaboration[30]. 21st-century learning allows students to have new knowledge and skills, the ability to connect their knowledge with new information, analyze, and cooperate with others. Media that supports 21st-century learning are information and communication technology (ICT), such as computers, networks, and other digital and non-digital computing technologies, as well as audio, video, and others[7]. Effective use of ICT in learning accommodates students to work collaboratively and solve problems as a form of 21st-century learning[16]. The use of ICT in learning activities also positively correlates with student performance in the class[4]. Various benefits of using technology, especially ICT in improving the quality of students, underlie the importance of ICT utilization by teachers.

As stated in the previous sentences that ICT are seriously beneficial and essential in the scope of classroom learning, Mishra & Koehler[22] try to develop Technological Pedagogical and Content Knowledge (TPACK) framework. This framework is a form of development of Shulman's
Pedagogical Content Knowledge (PCK) design. Integrating technology, pedagogics, and subject matter content in the learning process in the classroom are seen as important. A good learning process has 3 main components of knowledge, namely Pedagogical Knowledge (PK), Content Knowledge (CK), and Technological Knowledge (TK), where the interactions/relationships of these three components are important in learning. The interaction of the 3 main components in TPACK resulted in 4 other knowledge components, namely PCK (Pedagogical Content Knowledge), TCK (Technological Content Knowledge) TPK (Technological Pedagogical Knowledge), and TPACK (Technological Pedagogical and Content Knowledge).

The teacher must have TPACK because it attracts students' learning interest in the subject matter delivered. Knowledge about TPACK will make it easier for teachers to teach science material clearly to students. Biology is one part of science, in biology learning students are required to memorize various scientific names and understand fact material that students cannot easily see. Facts that are not seen directly by students can cause students to have difficulty understanding biology subject matter. The main topics that are difficult for students to learn include the material cycle, endocrine systems and hormones, aerobic respiration, cell division, and genetics. Combining ICT in learning especially biology learning will make it easier for students to understand the material presented by the teacher. In addition, students and teachers will find it easier to get new information related to biology subject matter by utilizing ICT. Therefore, it has become an obligation for teachers to mastery TPACK, characterized by use of technology in biology learning process.

Various factors influence teacher performance, both internal and external factors. One factor that influences the performance of biology teachers is teacher salaries. In order to improve teacher performance and the quality of education, the Indonesian government has provided salary increases for professional teachers who meet the qualifications. This is stated in the law number 14 of 2005 concerning teachers and lecturers. The teacher has the right to receive a professional allowance of one time the basic salary if has an educator certificate. The teacher's certificate can be obtained by the teacher by participating in the certification program.

Teacher certification is the process of giving recognition in the form of a certificate of an educator to someone who has the competence to do his job after passing the competency test held by the certification institution. The implementation of teacher certification program is believed to determine the quality of teachers in carrying out their duties as professional teachers, improve learning processes and outcomes, improve teacher welfare and teacher dignity. Teachers who have gone through certification programs are more competent in teaching practices and make it easier for students to understand the material taught. Biology teachers who already have teacher certificate are expected to be able to mastery TPACK better than un-certified.

Based on the description that has been stated, needed to analyse TPACK profile of biology teacher. It was also important to find out the difference TPACK profile of certified biology teachers and un-certified biology teachers.

2. Methodology

2.1. Research Design
This research was a descriptive study with a quantitative approach. Data collection was done using a survey method.

2.2. Research Sample
This research was conducted in Bantul Regency, one of the regency in the province of Yogyakarta Special Region. The population in this study were all high school biology teachers in Bantul who were hypothetical. The sample in this study were 38 biology teachers from 23 high schools taken based on convenience sampling techniques.
2.3. Research Instrument

The instrument used in this study was the observation sheet. The observation sheet instrument consisted of 46 items, including PCK components (18 items), TCK (10 items), TPK (11 items) and TPACK (7 items). The empirical validity of the observation sheet instrument is known from the Biserial Correlation value, each statement shows \( R \) count > \( R \) table (0.602). The reliability of the observation sheet instrument is known from the Intraclass Correlation Coefficient (ICC) value, which is 0.949 (PCK); 0.921 (TCK); 0.968 (TPK); 1.000 (TPACK). The instrument of observation sheet uses Guttman scale completed with 'yes'-'no' as its alternative answer. Furthermore, 1 is a score given to the 'yes' answer and 0 is a score given to the 'no' answer.

2.4. Data collection

Data collection was conducted from October 2018 to March 2019. This study used observation techniques in obtaining quantitative data regarding TPACK profile in the learning process. The observation is done in one time during the biology learning process.

2.5. Data Analysis

Data of TPACK is analyzed by descriptive and inferential. The descriptive analysis aimed to determine TPACK profile of biology teacher in the learning process. The inferential analysis aimed to determine differences in the TPACK profile of biology teachers based on certification status.

Descriptive analysis was taken by finding the minimum value, maximum value, mean, standard deviation, and criteria. The score for each TPACK component was changed to a value form, provided that:

\[
\text{value per component} = \frac{\text{score obtained}}{\text{maximum score for each component}} \times 100
\]

The values obtained were then analyzed to find out how the TPACK profile of the biology teacher. The criteria for the TPACK profile were based on the criteria according to Arikunto\[2\] which are presented in Table 1.

| Table 1. Criteria for Profile of Teacher's TPACK |
|-----------------|-----------------|
| Nilai | Criteria |
| 84 – 100 | Very Good |
| 68 – 83 | Good |
| 52 – 67 | Fair |
| 36 – 51 | Poor |
| \( \leq 35 \) | Bad |

The inferential analysis was using Independent sample t-test. If the probability score was greater than 0.05 (\( p < \text{Sig. 0.05} \)), there was a significant difference between the certified teacher and un-certified in terms of the mastery TPACK.

3. Result and Discussion

3.1. Result

TPACK profiles of high school biology teachers in Bantul Regency are obtained from the observation of the biology learning process. TPACK profile of biology teacher was emphasized the integration of PK, CK, and TK components. Therefore, the TPACK profile of biology teacher is only viewed from 4 components, i.e PCK, TCK, TPK, and TPACK components. The TPACK profile of high school biology teachers in Bantul Regency can be seen in Table 2.
Table 2. TPACK Profile of Biology Teacher in Bantul Regency

| Component | N  | Minimum | Maximum | Mean  | SD    | Criteria |
|-----------|----|---------|---------|-------|-------|----------|
| PCK       | 38 | 33.33   | 100     | 72.66 | 17.39 | Good     |
| TCK       | 38 | 0       | 100     | 22.89 | 20.91 | Bad      |
| TPK       | 38 | 0       | 100     | 33.49 | 27.08 | Bad      |
| TPACK     | 38 | 0       | 100     | 34.21 | 26.89 | Bad      |
| Average   | 38 | -       | -       | 40.81 | 23.07 | Poor     |

The results showed that the PCK profile of biology teacher were in good criteria, nevertheless the TCK, TPK, and TPACK components were in bad criteria. Based on the average of all TPACK components (including 4 components), biology teachers are poor at mastering TPACK with a value of 40.81.

The status of teacher certification was divided into certified teachers and un-certified teachers. The TPACK profile of high school biology teachers in Bantul Regency with differences in certification status can be seen in Table 3.

Table 3. TPACK Profile of Biology Teacher with Differences in Certification Status

| Component | Group      | N  | Mean   | SD    | Criteria | t       | P (two tailed) |
|-----------|------------|----|--------|-------|----------|---------|---------------|
| PCK       | Certified  | 32 | 73.78  | 18.41 | Good     | 0.918   | 0.365         |
|           | Un-certified | 6  | 66.67  | 9.29  | Fair     |         |               |
| TCK       | Certified  | 32 | 25.63  | 20.78 | Bad      | 1.925   | 0.062         |
|           | Un-certified | 6  | 8.33   | 16.02 | Bad      |         |               |
| TPK       | Certified  | 32 | 37.22  | 26.47 | Poor     | 2.039   | 0.049*        |
|           | Un-certified | 6  | 13.64  | 22.82 | Bad      |         |               |
| TPACK     | Certified  | 32 | 38.39  | 26.27 | Poor     | 2.345   | 0.025*        |
|           | Un-certified | 6  | 11.91  | 18.99 | Bad      |         |               |
| Average   | Certified  | 32 | 43.76  | 20.34 | Poor     | 2.157   | 0.038*        |
|           | Un-certified | 6  | 25.14  | 11.99 | Bad      |         |               |

Judging from the mean value, certified biology teachers were better at mastering the components of PCK, TCK, TPK, and TPACK than un-certified biology teachers. The inferential analysis results showed that there was no difference in mastery PCK and TCK between certified biology teachers and un-certified biology teachers because the probability value was greater than 0.05 (p > 0.05). Whereas the TPK and TPACK components obtained a probability value smaller than 0.05 (p <0.05), meaning that the mastery of TPK and TPACK was significantly different between certified biology teachers and un-certified biology teachers. The mastery of TPACK as a whole (including 4 components) showed a significant difference between certified biology teachers and un-certified biology teachers, with p = 0.038 (p <0.05).

3.2. Discussion

3.2.1. TPACK Profile

The TPACK profile of biology teacher in Bantul Regency showed that the PCK component of the biology teacher was in good criteria. This indicated that high school biology teachers in Bantul Regency were able to integrate pedagogical knowledge with biology subject matter. The mastery of PCK could be seen from the number of teachers who were able to: (1) adjust material with approaches, models, and learning methods, (2) adjust material with learning media, (3) adjust material to student character, (4) adjust material with assessment, and (5) teacher and student interactions were seen during the learning process. PCK was the teacher's knowledge framework on how to deliver material effectively and efficiently in the learning process[37].
It is known that in the learning process the teacher will face various students with various characteristics, abilities, and needs, therefore the teacher must have good teaching skills. Teaching is not only limited to the transfer of knowledge to students, nevertheless the teacher must also make students understand well the knowledge that shared by the teacher, also instill a variety of values and characters that are good for the future of students. Effective learning processes require content knowledge and in-depth understanding of how to facilitate students to learn the content of knowledge delivered\cite{3}. Effective and efficient learning can be created by mastering PCK.

PCK is the right predictor of what the teacher knows and what the teacher actually does in the classroom\cite{32}. Complex interactions between knowledge of content, teaching, and students in the learning process are depend on the mastery of PCK that the teacher has\cite{8}. PCK that the teacher has affects the learning outcomes and student motivation in the learning process\cite{8,14}. Based on this, it is very important for biology teachers to develop their PCK in teaching practices therefore the material presented is easily accepted by students and easily organizes classroom situations.

The TCK, TPK, and TPACK profile of biology teachers was not good. This fact showed that most high school biology teachers in Bantul had not been able to integrate the use of ICT in supporting the teaching and learning process. Seen in the learning process observation, many teachers had not been able to: (1) adjust material with ICT, (2) adjust ICT with approaches, models, methods and learning media, and (3) adjust ICT, learning materials, approaches, models, methods and learning media with student characteristics. The fact that the integration of ICT in learning had not been maximally implemented could lead to a lack of information development and knowledge received by students. ICT can facilitate a learning process in obtaining true, accurate, and transparent information therefore Indonesian education has competitiveness with other countries\cite{25}.

ICT that is exemplified by the internet and interactive multimedia clearly need to be effectively integrated into the learning process by teachers\cite{35}. Actually the use of ICT in the learning process makes it easy for teachers to convey the content of biology material attractively therefore student’s interest in learning biology increases. ICT is currently very important in the learning and teaching process, students can access various information, images and videos through electronic gadgets, while teachers can upload articles, pictures and videos using ICT-based tools\cite{33}. The success of the integration of ICT in the teaching and learning process depends on the abilities, skills, and creativity of the teacher in utilizing ICT\cite{1}.

Ineffective use of ICT can be caused by a lack of teacher knowledge about ICT-based learning media. Based on the results of the interview, it was revealed that some teachers did not understand the technology and its use. Basically, teachers have been able to use the internet to communicate and obtain information nevertheless had not been able to use it in learning. Meenakshi \cite{20} revealed that many teachers were reluctant to use ICT, especially computers and the internet, the reasons being among others, teachers lacked trust in the effectiveness of using ICT in improving learning outcomes, lack of school support, the need for time and effort to learn how to use ICT in learning, and fear of losing authority because it was more student-centered.

The results of observations in the field illustrated that many teachers who use technology by teachers were limited to using power points and videos to support the learning process. Although there were some teachers who utilized internet facilities, it seemed that teachers were less creative in using them. The use of the internet in learning was mostly done by students, the teacher only asked students to use the internet for additional information in completing the tasks given by the teacher.

The poor ability of biology teachers to integrate ICT in teaching practices was very unfortunate. Teachers should be able to meet the demands of the development era with the use of technology in accommodating student learning activities. The importance of the use of ICT in the world of education and the demands of the digital era should alert teachers to develop their TPACK. The poor mastery of TCK, TPK, and TPACK of high school biology teachers in Bantul should be an evaluation material both by teachers, schools and the government.

3.2.2. TPACK Profile Based on Certification Status
Certified biology teachers are better at mastering the components of PCK, TCK, TPK, and TPACK than un-certified biology teachers. In line with this, Kartowagiran[13], Palupi[33], Nuraeni & Retnawati[27] revealed that certified teachers were good at carrying out classroom learning. The inferential analysis results showed that the mastery of PCK and TPK was not significantly different between certified biology teachers with un-certified biology teachers. The mastery of PCK that did not differ significantly in the two groups of teachers could be caused of both groups of teachers were almost the same in choosing learning strategies, teaching materials, and learning media. Discussing learning strategies, approaches and models that were widely used by both groups of teachers was the scientific approach with the model of Discovery Learning and Problem Based Learning (PBL). Regarding the learning method, both certified biology teachers and un-certified biology teachers often used the method of discussion and presentation. Teaching materials and learning media that were often used by both groups of teachers were textbooks, internet sources, and power point media.

Widodo[39] revealed the fact that most certified teachers had the ability to open lessons with sufficient criteria, nevertheless the ability to implement learning strategies, teach materials, and encourage active students belong to bad criteria. Although the mastery of PCK and TPK did not show a difference between certified teachers and un-certified teachers, Helding & Fraser[11] proved that rather than certified teachers, certified teachers had a good attitude and were able to create a learning environment students were better.

The mastery of TCK and TPACK had a probability value smaller than 0.05 therefore it was concluded that the mastery of TCK and TPACK was significantly different between certified biology teachers with un-certified biology teachers. Certified biology teachers had the mastery of TCK and TPACK better with mean value 37.22 and 38.39, while un-certified biology teachers obtained mean value 13.64 and 11.91. Overall (including 4 components), the mastery of TPACK of certified biology teachers differed significantly from un-certified biology teachers. These results indicated that certified biology teachers were able to use ICT well in learning compared to un-certified biology teachers. This result was in line with Farida & Pratiwi[9] that there was a difference in performance between certified teachers and un-certified teachers in the learning process.

The difference in the mastery of TPACK between a certified biology teacher and a un-certified biology teacher can be caused the certified teacher has responsibility and demands for his title as professional teacher. Certified teachers are required to have the ability to use a variety of learning strategies, maximize educational facilities, and innovate in the learning process therefore students are interested in learning[17]. Teacher certification required teachers to have innovation in creating learning methods that were in accordance with student characteristics[80]. Teacher certification could also improve teacher welfare, dignity, discipline and pedagogical competence[29].

4. Conclusion

Based on certification status, certified biology teachers were better at mastering the components of PCK, TCK, TPK, and TPACK than un-certified biology teachers. However the result of inferential analysis show that the mastery of PCK and TCK is no different between certified biology teachers and un-certified biology teachers, certification status has more influence on the mastery of TPK and TPACK.

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