

The Analysis of 21st Century Teachers' Ability in Technological Pedagogical Content Knowledge

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Abstract-This study aimed to analyze how the ability of biology teachers forum (called as MGMP Biology teachers) on the 21st century TPCK. This case study was conducted on 10 MGMP Biology teachers from different schools as the participants. The data were collected by using a questionnaire. The data analysis was conducted descriptively based on 7 components in TPCK of the 21st century: Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK) and Technological Pedagogical Content Knowledge (TPCK). The results showed that the mean PK (2.90), CK (2.40), TK (2.25), PCK (1.92), TPK (1.93) and TPCK (1.97) TCK with averages (1.73) was categorized as very less ability. This result shows that the ability of 21st century TPCK of the teachers still needs to be improved on the aspects of content mastery, pedagogy and technology.

Keywords-TPACK; 21st Century

I. INTRODUCTION

The teacher as an educator is one of the important factors in achieving educational goals. The learning process, in general, always applies the aspects of pedagogy and content. In the education of 21st century, of course, the teachers should be able to use technology to help them in the learning process. Technology is also one of the processes to make people being educated in the digital era (Partnership for 21st Century Skills, 2014). Because of that, there is a theoretical framework in the use of information and communication technology for teachers namely as Technological Pedagogical Content Knowledge (TPCK).

TPCK is a framework for integrating the use of technology in teaching. TPCK is divided into 7 components [2]. They are Pedagogical knowledge (PK), Content Knowledge (CK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge TPCK [2]. The Framework of TPCK serves as a theory and concept for researchers in measuring the readiness of teachers and prospective teachers in teaching effectively

with technology. TPCK development should begin with a variety of the simple technology and then gradually turn to more sophisticated technology in the 21st century. Along with the current development, the school is challenged to make the students be success in work and life through the mastery of creative thinking skills, critical thinking skills, flexible problem solving, communicating, collaborating and innovating. This kind of training to improve these skills can be held by the school to help the students to prepare for the world of work and life in the 21st century [1].

There is a new challenge for teachers that they should be able to use various pedagogical approaches with technology to support the 21st century skills of the students [3]. The Partnership for 21st Century Learning demonstrates the importance of 21st century skills to achieve the transformation in order to be able to compete [4].

II. METHOD

This research used the case study research method. The subject of this research was the group of teachers who are members of the Biology Teachers' Forum (MGMP Biology) of West Bandung Regency. The participants in this study were 10 teachers from different schools. The data collection was done through a questionnaire which consists of 7 TPCK components with a total of 38 statements filled by each participant. This instrument was adopted from TPCK instrument for 21st century skill developed by Valtonen [3]. With the following assessment criteria:

TABLE I. CRITERIA INTERVAL VALUE

Interval values	Criteria
> 4.20 - 5.00	Very good
> 3.40 - 4.20	Good
> 2.60 - 3.40	Enough
> 1.80 - 2.60	Less
> 1.00 - 1.80	Very less

Widoyoko (in Suryawati, Firdaus, & Hernandez, 2014)

III. RESULTS AND DISCUSSION

Based on the results of the questionnaire distribution, the 7 TPACK component data will be described as follows.

A. Pedagogical Knowledge (PK)

Based on the data analysis, the statements obtained from PK teacher profile of MGMP Biology are presented in Table II.

TABLE II. SCORES PK MGMP BIOLOGY TEACHER.

Statement	Average	Criteria
1. Guide a discussion during group work (2-5 students)	2.20	Less
2. Support the students to think critically	2.10	Less
3. Guide the students in planning their own learning	1.90	Less
4. Support the students to do a reflective thinking	1.90	Less
5. Guide the students to take advantage of each other's ideas during group work (2-5 students)	2.00	Less
6. Support the students in doing the problem-solving skills	2.20	Less
7. Support the students to think creatively	2.30	Less
Average Total	2.09	Less

Based on the table, it could be seen the average score of MGMP biology teachers is on the criteria less. Pedagogical knowledge is the knowledge of processes and practices or methods of teaching and learning so that the purpose of education can be realized [2]

In the 7 PK statements, 4 statements are the specific components discussing the 21st century, the average result seen in the 4 statements were still lacking because the teachers did not yet implemented a learning strategy relating to the 21st century skills. These skills are needed to be integrated into the process of teaching and learning in educational field as a means and purpose of learning.

B. Content Knowledge (CK)

Based on the data analysis, the statements obtained from CK teacher profile of MGMP Biology are presented in Table III.

TABLE III. SCORES CK MGMP BIOLOGY TEACHER

Statement	Average	Criteria
1. I have sufficient knowledge in developing the contents of biology material	2.40	Less
2. I know the basic theories and concepts of biology material	2.80	Enough
3. I know the history and development of important theories in biology	2.40	Less
4. I know the latest research in biology	2.00	Less
Average Total	2.40	Less

The mean score of CK of MGMP Biology teacher was in less criteria. However, on the item statement 2 that said "I know the basic theories and concepts of biology material" were on enough criteria. It could be meant that the teacher has enough knowledge about the basic theories of biology. Based on understanding Content knowledge, it is defined as the knowledge of teachers about the subject matter/ content that is learned or taught. The teacher must understand the

nature of knowledge and find the differences among the each basic knowledge in order to provide information that is easily accepted by the student [2].

C. Technological Knowledge (TK)

Based on the data analysis, the statements obtained from TK teacher profile of MGMP Biology are presented in Table IV.

TABLE IV. SCORES TK MGMP BIOLOGY TEACHER

Statement	Average	Criteria
1. I can solve problems related to ICT	2.20	Less
2. I know the new technologies and their features	2.40	Less
3. I can use the latest technology	2.20	Less
4. I know some sites about the new technology	2.20	Less
Average Total	2.25	Less

Based on the table above, it could be seen the mean score of kindergarten MGMP teacher that is in less criteria. This illustrated that the teacher's ability of Technological Knowledge related to the information technology still needs to be developed. Technological knowledge is defined as the knowledge of technology that can be utilized to support learning so that it can improve other aspects because the teacher's knowledge about information technology is the basic aspect of model TPCK (Jordan, 2011).

It is needed to be highlighted that the students need to be able to achieve the expected competencies to face their future and the teachers should to guide them by using various pedagogical and ICT approaches in supporting the development of 21st century skills [5].

D. Pedagogical Content Knowledge (PCK)

Based on the data analysis, the statements obtained from PCK teacher profile MGMP Biology are presented in Table V.

TABLE V. SCORE PCK MGMP BIOLOGY TEACHER

Statement	Average	Criteria
1. In biology material, I know how to guide the students in solving the problems related the content in groups (2-5 students)	1.90	Less
2. In biology material, I know how to guide the students to think critically	1.90	Less
3. In biology material, I know how to guide students to take advantage of one idea with others in group work (2-5 students)	1.80	Less
4. In biology material, I know how to guide the students to think	2.00	Less
5. In biology material, I know how to guide the students in planning their own learning	2.00	Less
6. In biology material, I know	1.90	Less

Statement	Average	Criteria
how to guide the students to think creatively		
Average Total	1.92	Less

The mean score of PCK teacher of MGMP Biology was in less criteria. It showed that the teacher did not applied PCK. PCK is defined as the knowledge of teachers in choosing learning methods, approaches, models in teaching content to students in order to create a better teaching [2].

PCK plays an important role in offering the teachers thinking strategies, teaching tips and tricks, and encouraging them to explore practice understanding based on a better relationship between learning objectives and the learning process [6].

E. Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge is the knowledge of how diverse technologies can be used in teaching and the use of such technologies is able to change the way teachers teach [2]. Based on the data analysis, the statements obtained from TPK teacher profile of MGMP Biology are presented in Table VI.

TABLE VI. SCORE TPK MGMP BIOLOGY TEACHER

Statement	Average	Criteria
1. I know how to use ICT in teaching as a measurement tool for the students' reflective thinking	1.90	Less
2. I know how to use ICT in teaching as a tool for students to plan their own learning	2.10	Less
3. I know how to use ICT in teaching as a tool for sharing ideas and thinking together	2.10	Less
4. I know how to use ICT in teaching as a tool for creative thinking students	2.00	Less
5. I know how to use ICT in teaching as a tool for students to solve the problems in groups (2-5 students)	1.70	Very less
6. I know how to use ICT in teaching as a tool for critical thinking students	1.80	Less
Average Total	1.93	Less

The mean score of TPK of MGMP Biology teacher was in less criteria. The lowest average was in the question items 5 that is "I know using ICT in teaching as a tool for students to solve problems in groups (2-5 students)".

Using ICT as an informal learning resource enables the students to have high collaboration skills, easy sharing and exchange of knowledge, and self-directed to continue learning to solve the problems. Integrating the ICT into the context of teaching and learning gives various results in the form of an interaction between teachers and learners as well as the interaction among fellow learners [7]. Trilling believed that children generally acquire positive social skills through daily interactions with adults and their peers [8].

F. Technological Content Knowledge (TCK)

Technological content knowledge is knowledge of how to reconnect technology and content mutually [9]. Based on the data analysis, the statements obtained from TCK teacher profiles MGMP Biology are presented in Table VII.

TABLE VII. SCORE TCK MGMP BIOLOGY TEACHER

Statement	Average	Criteria
1. I know a website with online materials to study biology materials	1.80	Very less
2. I know the ICT applications used by professionals in biology materials	1.50	Very less
3. I know the ICT applications that I can use for a better understanding of the content of the biology material	1.90	Less
4. I know the technology I can use in facing the difficult content in biology	1.70	Very less
Average Total	1.73	Very less

The mean score of TCK of MGMP Biology teacher was on very less criteria. This component is the lowest average compared to the others. In research Suryawati et al., (2014) also showed the limited knowledge of teachers on computer applications related to the learning of biology. The teachers need to know not only the subject matter they teach but also the way in which the subject matter can be changed by technology applications. In other words, technology can serve as a representative model for specific content [10].

G. Technological Pedagogical Content Knowledge (TPCK)

TPACK is the knowledge needed by teachers to integrate technology into the teaching of certain material, into a complete package (Mishra & Koehler, 2006). Teachers should have an intuitive understanding of the complex interactions between the three basic components of knowledge, namely PK, CK and Kindergarten, by teaching certain material using appropriate pedagogical and technological methods [10].

Based on the data analysis, the statements obtained from TPCK teacher profiles of MGMP Biology are presented in Table VIII.

TABLE VIII. SCORE TPCK MGMP BIOLOGY TEACHER

Statement	Average	Criteria
1. In teaching biology material, I know how to use ICT as a tool for sharing ideas and thinking together	2.20	Less
2. In teaching biology material, I know how to use ICT as a measuring tool for reflective thinking students	2.00	Less
3. In teaching biology material, I know how to use ICT as a tool for the students to plan their own learning	2.00	Less
4. In teaching biology material, I know how to use ICT as a tool to solve the student groups problems (2-5 students)	1.80	Very less
5. In teaching biology material, I	1.90	Less

Statement	Average	Criteria
know how to use ICT as a tool for creative thinking students		
6. In teaching biology material, I know how to use ICT as a tool in group work (2-5 students)	2.10	Less
7. In teaching biology material, I know how to use ICT in teaching as a tool for critical thinking students	1.80	Very less
Average Total	1.97	Less

The average score of TPCK MGMP teachers Biology was on the less criteria. Teachers have not been able to apply TPCK. It can be seen from the statement items number 4 and 7 that say “In teaching biology material, I know how to use ICT as a tool to solve the student groups problems (2-5 students)” and “In teaching biology material, I know how to use ICT in teaching as a tool for critical thinking students”. The question item is 2 of the 4 21st century skills statements. Teachers create meaningful learning activities, strategies and contexts are appropriate to student life, then cooperation, communication, critical thinking skills and student academic achievement increase [8].

From the description of the ability of MGMP teachers in applying TPCK 21st century can be seen in Figure 1.

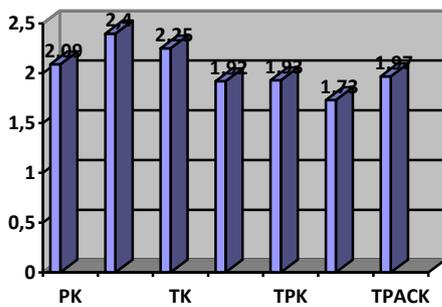


Fig 1. Average teacher ability at every TPCK component.

In general, the statements about the knowledge of the MGMP biology teacher in applying TPCK with an average of 1.97 are in less criteria. The results showed that the mean PK (2.90), CK (2.40), TK (2.25), PCK (1.92), TPK (1.93) and TPACK (1.97) TCK with averages (1.73) is categorized very

less. This shows that teachers are still hesitant about applying technology to learning. In accordance with research Pusparini, Riandi, & Sriyati (2017) despite high technological knowledge, but TCK was lower than kindergarten which means the preservice teacher is still hesitant to apply technology in animal physiology material.

IV. CONCLUSION

Based on the results of this research, it can be concluded that the ability of TPCK-21 MGMP Biology teachers is in less criteria. However, the TCK component is still poorly categorized, so the teachers need to develop the technological ability of pedagogical content knowledge to improve the learning quality in facing the 21st century.

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