

Analysis Technological Pedagogical Content Knowledge Ability of Teachers

Junairoh Kestiani, Riandi, Diana Rochintaniawati

Departemen Pendidikan Biologi
Universitas Pendidikan Indonesia
Bandung, Indonesia
junairohkestiani@student.upi.edu

Abstract–This research aims to describe the ability of technological pedagogical content knowledge (TPACK) high school biology teacher in West Bandung Regency on growth and development material. The research method used is case study. Research subjects are high school teachers, who are involved in the subject matter teachers (MGMP) biology of West Bandung Regency with the number of participants as many as 4 biology teachers from different schools. The instrument used as a data collection tool in this research is CoRe. The results show that the ability of technological pedagogical content knowledge (TPACK) biology teacher is at "moderate" level in the sense of showing the advent of technological pedagogical content knowledge.

Keywords–TPACK; CoRe instrument

I. INTRODUCTION

The rapid development of science and technology is a challenge that teachers must address by integrating technology into learning. Integrating technology into the learning process by teachers can be one way to improve the quality of learning. To be able to create effective learning, a teacher must understand and have the ability of Technological Pedagogical Content Knowledge (TPACK) on them [1].

TPACK is a framework that integrates technology into the learning process and TPACK is a link between technology, pedagogy and content [2]. TPACK requires interaction between content, pedagogy and technology [3]. TPACK is an amalgamation of three domains of knowledge are content, pedagogy and technology with a goal to develop basic knowledge when teachers study learning materials and understand how technology can enhance the experience for learners as well appropriate pedagogical knowledge to improve the quality of learning [4].

Concept of Pedagogical Content Knowledge (PCK) by adding technology [5]. PCK is a knowledge developed by teachers over time and through experience on how to teach certain content in a certain way to improve students' understanding

[6]. One form of TPACK application in learning is the use of technology in teaching certain materials. Integrating technology into biology learning is essential to respond to the challenges of the 21st century [7]. Teachers are not only required to have the ability of PCK, but also apply technology into learning so that knowledge about technology, pedagogy and content must be owned by teachers.

TPACK has a very important role to achieve the learning objectives [8]. TPACK owned by a prospective teacher can influence the way the teacher in teaching a material in the learning process [9]. The ability of integrating technology into learning is essential as the rapid development of science and technology. Where with the technology can help a teacher in professional development.

Teachers in all disciplines must learn how to design and develop technologies that can foster student success in the learning environment [10]. In addition, teachers should use better technology to follow the development of biology learning, as well as in the use of technology and learning strategies adapting to the material and learners. In biology learning, teachers with TPACK perspectives are teachers who understand the pedagogy and understanding the correct concept by using technology to teach the subject matter.

Characteristics of growth and developmental materials require learning that involves the role of students in finding concepts and also understanding the concept of matter. Research on CoRe has been widely practiced, one of which is used to improve PCK teacher Biology [11] indicates that pedagogical content knowledge of biology teachers on human and environmental concepts is in medium category and prospective teachers in high category.

II. METHOD

The research method used is case study. This is because TPACK is very specific from aspects of content (teaching materials), pedagogy and technology so it needs to be analyzed in depth. Research subjects in this study are biology teachers who are involved in the subject matter teachers

(MGMP) biology of West Bandung Regency with the number of participants as many as 4 biology teachers from different schools. The instrument used as a data collection tool in this research was CoRe adapted from (Loughran, J., Berry, A. , Mulhall (2012). CoRe is a format used to represent content and document the ability of a teacher's PCK when planning a lesson (Nilsson & Loughran, 2011). The collected research data is then analyzed descriptively.

III. RESULT AND DISCUSSION

The development of TPACK teachers is grouped based on the five components in the learning activities, namely: 1) learning objectives, 2) selection of important concepts, 3) pedagogy, 4) evaluation, and 5) technology TPACK image of teachers in planning learning material growth and development obtained from the results of CoRe analysis and teacher interview results. The results of CoRe analysis have been made by the teacher.

A. Teacher's knowledge of goals in material growth and development

The teacher's knowledge of the goals in the material of growth and development includes the determination of the learning objectives according to the curriculum demands. In general, the learning objectives made by teachers are based on curriculum and syllabus demands using operational verbs at the level of C1-C6 cognitive knowledge. Developing learning tools that meet TPACK criteria not only inserts the use of technology in learning but rather lies in the analysis of objectives and learning activities [12].

B. Teacher's knowledge of concepts in matter of growth and development

The teacher's knowledge of concepts includes any concepts that are considered important to be taught to learners as well as consideration in the selection of important concepts. Some important concepts that teachers choose to teach to learners can be seen in table I.

TABLE I. CONCEPTS TO BE TAUGHT ON GROWTH AND DEVELOPMENTAL MATERIALS

Teacher	Concepts to be taught
Teacher A	Understanding and different terms and stages of growth and development External factors that affect growth and development Internal factors that affect growth and development Designing experiments of growth and development
Teacher B	The concept of growth and development Plan and carry out the experiment
Teacher C	Growth and development Factors that affect growth and development Plant hormones
Teacher D	Understanding growth and development External factors that affect growth and development Internal factors that affect growth and development Primary growth in plants Secondary growth in plants

From table I shows that there are two concepts that tend to be taught to learners that is understanding growth and development and growth factors and developments. This is because teachers consider that the two concepts are basic concepts so that students can understand the next concepts. Based on the basic competencies on growth and development material, there are two important ideas or concepts not written by most teachers that are the kinds of growth and development (primary growth and secondary growth) and the stages of growth and development of plants. The teacher's consideration in choosing the concept to be taught on growth and development material can be seen in table II.

TABLE II. TEACHER'S CONSIDERATION IN CHOOSING THE CONCEPT TO BE TAUGHT

Teacher	Consideration of concept selection
Teacher A	Curriculum Concept announcement Ability and knowledge of learners Proximity to learners
Teacher B	Curriculum Concept announcement

Teacher C	Curriculum Concept announcement Proximity to learners
Teacher D	Curriculum Concept announcement Ability and knowledge of learners Proximity to learners

Based on table II, teachers are more likely to choose concepts based on curriculum demands and concept announcements. The concept announcement is the concepts that are generally found in textbooks. Based on CoRe analysis, the concept chosen by the teacher tends to be unclear as to the extent of its breadth and depth. Teachers usually choose common concepts that are often present in national exams. Generally teachers are still difficult to express the limits of the depth or breadth of the concept chosen so that usually the selected concept is a general concept [13].

C. The teacher's knowledge of pedagogy in the material of growth and development

The teacher's knowledge of pedagogy encompasses the way the teacher represents

concepts to be taught with strategies that fit the concept. The selection of teaching strategies on growth and development materials can be seen in table III.

TABLE III. SELECTION OF TEACHING STRATEGIES ON GROWTH AND DEVELOPMENTAL MATERIALS

Teacher	A teaching strategy
Teacher A	Lecture Question and answer Discussion Project based learning
Teacher B	Lecture Question and answer Project based learning Discovery learning
Teacher C	Lecture Question and answer Discussion Conceptual approach Research assignment
Teacher D	Lecture Question and answer Discussion Project based learning Observation Practice

The concepts on growth and developmental materials have different conceptual characteristics that require different ways of teaching. For example on the concept of growth and development stages and the factors that affect growth and development have different concept characteristics. Table III shows that the teaching strategies most teachers choose are lectures, questions and answers, discussions and project based learning. Generally in choosing a strategy, some teachers have considered the characteristics of the concept, but there are still teachers who are less precise in choosing the appropriate strategy with the concept to be taught.

Based on Permendikbud No. 103 years 2014 Article 2 paragraph 1, teachers should be able to design an activity-based learning strategy with the characteristics of: a) interactive and inspirational; b) fun, challenging, and motivating learners to participate actively, c) contextual and collaborative; d) sufficient for the initiative, creativity and independence of learners, and e) in accordance with the talents, interests, abilities and physical and psychological development of learners. One of the teaching strategies that can be applied to the material of growth and development is the inquiry model of learning. This is in line with research conducted by Lailah (2012) that the application of inquiry model is well applied to support the process of teaching and learning activities material growth and development.

D. The teacher's knowledge of evaluation in the material of growth and development

The teacher's knowledge of evaluation in growth and developmental materials includes how to assess learners on growth and developmental materials.

The teacher's selected assessment to evaluate growth and development material can be seen in table IV.

TABLE IV. SELECTION OF EVALUATION ON GROWTH AND DEVELOPMENTAL MATERIALS

Teacher	Evaluation
Teacher A	Writing test Oral test
Teacher B	Writing test Assignment of tasks Portfolio
Teacher C	Writing test Oral test Assignment of tasks
Teacher D	Writing test Oral test Assignment of tasks Skills assessment Assessment of attitude

The form of assessment required in the Curriculum 2013 is an authentic assessment that should include the three domains of knowledge, attitudes and skills using some assessment techniques: written assessment, attitude assessment, performance assessment, product assessment, project assessment, portfolio assessment and self assessment (Permendikbud number 23 of 2016 on Education Assessment Standards). Based on table IV, the selection of assessments in material growth and development varies considerably. Teachers tend to use written tests and assessment tasks to measure students' understanding because they can assess more concepts. In general, the assessment used by teachers has considered the concepts being taught. However, teachers tend to only conduct knowledge assessment without assessing the attitudes and skills of learners.

E. The teacher's knowledge of technology in material growth and development

The teacher's knowledge of technology in the material of growth and development includes the selection of technologies that fit the concepts and strategies used. The technology that teachers choose for the material growth and development can be seen in table V.

TABLE V. SELECTION OF TECHNOLOGY ON GROWTH AND DEVELOPMENTAL MATERIALS

Teacher	Technology
Teacher A	Infocus projector Whiteboard and markers
Teacher B	Infocus projector Internet Microsoft office Whiteboard and markers
Teacher C	Infocus projector Whiteboard and markers
Teacher D	Infocus projector Android apps Digital auksanometer Whiteboard and markers

The technology referred to in this study is the tool to teach concepts to be more easily digested by learners. Based on Permendikbud number 22 of 2016 on Standard Process stated that the utilization of technology in learning to improve efficiency and

effectiveness of learning. To create effective learning requires the use of efficient technology in order to generate positive emotions in the learners during learning [14]. In general, the technology that biology teachers choose to teach growth and developmental materials includes conventional technology and modern technology and teacher-selected technology is effective and efficient for use in learning. The use of technology to study the concept of growth and development is specific to the concepts taught and strategies used. This is in line with research conducted by Agustin, R. R., Liliyasi, Sinaga, P., Rochintaniawati (2018), states that science teachers in the City of Bandung consider the characteristics of the concept as a major aspect to apply technology into the teaching of science.

F. An overview of TPACK ability teacher

TPACK teachers' ability is analyzed based on aspects of goals, concepts, pedagogy, evaluation and technology. The TPACK picture of the teacher can be seen in table VI.

TABLE VI. TPACK PICTURE OF THE TEACHER

Aspect	TPACK Type			
	Teacher A	Teacher B	Teacher C	Teacher D
Purpose	2	2	2	2
Concept	1	1	1	1
Pedagogy	2	1	2	2
Evaluation	2	2	2	2
Technology	2	2	2	2

Information:

1 = Low, 2 = Medium, 3 = Height

Based on the analysis of the five TPACK components discussed earlier, it can be concluded that TPACK teachers in planning learning material growth and development are at the level of "medium" in the sense indicating the emerging ability of technological pedagogical content knowledge. Teachers generally have been able to set goals, consider the competencies and needs of students and the demands of the curriculum. In terms of concept selection, teachers have been able to select relevant concepts but they are still general or have not shown the depth limit of the concept. In terms of strategy selection, some teachers have considered the characteristics of the concept, but there are still teachers who are less precise in choosing the appropriate strategy with the concept to be taught. In addition, the assessment used by teachers has considered the concepts being taught, but teachers tend to only conduct knowledge assessments without assessing the attitudes and skills of learners. Meanwhile, the use of technology to study the concept of growth and development has been specific to pay attention to the concepts taught and strategies used.

IV. CONCLUSION

Based on the result of the research, it can be

concluded that technological pedagogical content knowledge (TPACK) of biology teacher is at the level of "medium" in the sense of showing the emerging ability of technological pedagogical content knowledge. However, there are several aspects such as in determining important ideas or concepts on growth and development materials and determining strategies that are in accordance with the concept that will be taught is still not appropriate, so there is a need for a program that can develop the technological pedagogical content knowledge (TPACK) the quality of learning is increasing.

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