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THE TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) COMPETENCE OF VOCATIONAL HIGH SCHOOL TEACHER

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ABSTRACT

This study aimed to determine the Technological Pedagogical Content Knowledge (TPACK) competence of Vocational High School teachers. A descriptive method was implemented through a survey. This study location was 3 Vocational High Schools in Bandung City, West Java Province, Indonesia. Furthermore, the participants were 90 teachers. The TPACK competency evaluation instrument for Vocational High School teachers was based on its components, namely Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPACK). The results of this study showed the TPACK competence of the Vocational High School teachers was 3.68 which was classified as high (in 0 – 5 scale). The maximum and minimum score was 3.84 and 3.58 for the Content Knowledge and Technological Knowledge component, respectively. This indicates that the teachers had the highest competence in knowledge of subject matter content and the lowest in understanding and applying technology to learning. Therefore, there was still a need for efforts to improve the competence of these teachers in understanding and applying technology in learning.

Keywords: competence, TPACK, vocational high school teacher

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INTRODUCTION

The Vocational High School aims to prepare human resources that are ready to enter the labour market to have high leadership, discipline, professionalism, reliability in their field, and productivity. Vocational graduates are ideally middle-level workers that are ready to work, i.e, graduates can work in the business and industrial world (Chou, 2015). Lolo, et.al (2014) mention that the purpose of vocational education is to prepare students to work in a particular field. The purpose of vocational education is to prepare students to work in a particular field. In 21st-learning partnerships, the skills that are needed to be developed include learning and innovation, information, media and technology, and life and career skills. Furthermore, the changes in the 21st century are related to technological developments and variations in the labour market needs.

Therefore, mastering technology is a competency that should be possessed by vocational teachers (Oktarina, 2019). The 21st century teaching standards require teachers to use knowledge of teaching materials, learning processes, and technology to facilitate student learning experiences (Westriningsih, 2010)

The United Nations Educational, Scientific and Cultural Organization (UNESCO) framework emphasizes that teachers should be able to aid students to collaborate, solve problems and be creative through the use of Information and Communication Technology (ICT) to enable students to be job-ready graduates. Furthermore, students need to be taught how to use ICT as a means to generate new knowledge (Jong, 2008). Regarding educational quality, the improvement of teachers' competence is seen as one of the most crucial areas of action [6]. Also, teachers should ensure that they have good technological knowledge and skills to enable technology integration in learning effectively and efficiently (Cheng et.al, 2014) (Jones, & Lapkin, 2014). Productive teachers must be able to guide the students in mastering the knowledge, skills, attitude, and value that are needed in the workplaces. For that reason, teachers must have qualified knowledge and skills (Murtono and E. Miskiyah, 2014). As professional workers, teachers need to carry out continuously their skills improvement through professional development for performing their duties more professionally (Bell, et.al., 2013).

The application of technology in learning activities requires the following which includes competent teachers that are able to integrate mastery of the material, pedagogy, and technology in learning. These three abilities are called Technological Pedagogical Content Knowledge (TPACK) (Berg, 2009). The TPACK is a framework created by Mishra and Koehler [12]. It is a learning approach that combines materials, pedagogy and technology (Ahlehagh & Dey, 2014). Furthermore, it consists of components of TK, CK, PK, PCK, TPK, and TCK [14]. The TPACK framework is described as follows.

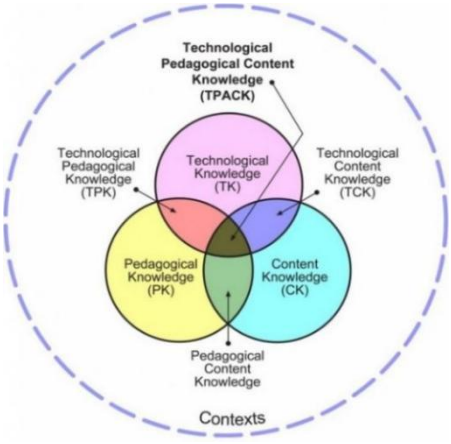

Figure 1. TPACK Framework (Berk, 2009; Cheng, et.al., 2014; Lackey, 2014)

The brief explanation of each TPACK component is as follows.

1. Technological Knowledge (TK)

TK describes technology products in the education field ranging from standard technology products to applied technology (Ngina, 2018). It not only refers to the instrumental skills required to operate the technology but also implies knowledge of the technology's ability to achieve certain goals (Wahyuningsih, et.al., 2019).

2. Content Knowledge (CK)

CK includes knowledge of concepts, theories, ideas, frameworks of thought, methods of proof, or procedures (Siregar & Nara, 2013).

3. Pedagogical Knowledge (PK)

PK is related to teaching methods and processes which include knowledge of classroom management, planning, implementation, and learning evaluation (Lestari, 2015).

4. Pedagogical Content Knowledge (PCK)

The PCK is the relationship between basic knowledge of content and pedagogy (Rifa'i & Anni, 2012). It is the ability to integrate subject matter with pedagogy in the development and application of better learning to specific content (Hamalik, 2011).

5. Technological Pedagogical Knowledge (TPK)

The TPK is knowledge about technology that can be used in learning and understanding that using certain technology products change the way teachers teach in the classroom (Siagian, 2015).

6. Technological Content Knowledge (TCK)

The TCK is teachers' knowledge of how technology provides a way of learning representation of specific content (Magfirah, et.al., 2015). Teachers need to understand that using technology changes the way students understand concepts in certain content areas (Berutu & Tambuan, 2018).

7. Technological Pedagogical Content Knowledge (TPACK)

The TPACK is knowledge of complex interactions between content, pedagogy and technology domains (Berk, 2009). It is teachers' knowledge about how to facilitate student learning of certain content through pedagogic and technological approaches (Nur'ainun, 2017). Furthermore, teachers should play a role in the technology integration process and have the competence to use the available technology appropriately and effectively (Achmad, et.al., 2018). They should master TPACK competencies to support an effective learning process. To discover this, it is necessary to evaluate. There are three benefits of TPACK evaluation which include obtaining a profile of TPACK mastery as an illustration of the level of mastery in each domain of knowledge, being a reflection in the provision of education for prospective teachers, determining the impact of learning interventions related to technology integration given to prospective teachers while pursuing teacher education (Schwabe, et.al., 2011).

METHOD

In this study, a descriptive method was implemented through a survey (Kemp & Dayton, 1985) to describe the TPACK competencies of the Vocational High School teachers. The study location was three Vocational High Schools in Bandung City, West Java Province, Indonesia. Furthermore, the participants involved in this study were 90 teachers. 76 teachers have a bachelor's degree and the rest of them have a master's degree, as shown in Figure 2. The TPACK competency evaluation instrument for Vocational High School teachers was based on the components listed in Table 1.

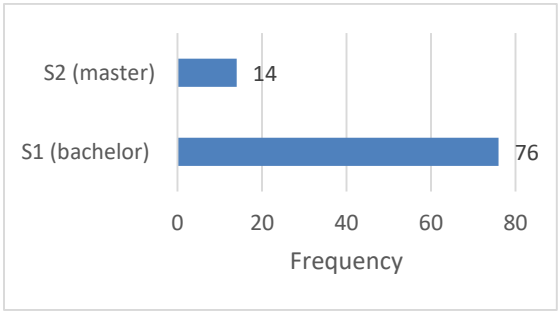

Figure 2. Number of participants based on educational level

Table 1. Description of TPACK Components

TPACK Components	Description
Technological Knowledge (TK)	Technology knowledge and ability to use technology in learning
Content Knowledge (CK)	Knowledge and understanding of the material taught includes facts, concepts, theories, and procedures
Pedagogical Knowledge (PK)	Knowledge and understanding of planning, process, media development, and learning evaluation
Pedagogical Content Knowledge (PCK)	Knowledge of how to combine subject matter with pedagogy to develop an effective learning process
Technological Pedagogical Knowledge (TPK)	Understanding of changes in learning methods and processes through the use of technology in learning
Technological Content Knowledge (TCK)	Technology knowledge that is following the objectives and subject matter and the effect of using technology on the subject matter or vice versa
Technological Pedagogical Content Knowledge (TPACK)	Knowledge to facilitate student learning about specific content through appropriate pedagogy and technology

The instrument developed consisted of 52 items. The Likert scale used ranged from one to five. Before using this instrument, a trial was carried out on 37 participants and the validity and reliability were calculated. The Validity test was to determine the instrument level accuracy (Susanto, 2016). Furthermore, testing the validity of each item using correlation analysis and the item is valid provided that it has a correlation coefficient greater than 0.4 (Mardiah & Akbar, 2018). The validity test results obtained 48 valid and four invalid items. Reliability is the

consistency of the instrument in measuring something that is the measurement object (Sawyer, et.al., 2012). In addition, the reliability testing with formula *Alpha Cronbach* (Bell, et.al., 2015) and the result was 0.96 with very high category.

In this study, descriptive statistical data analysis was carried out by calculating the average TPACK competence of teachers using the equation

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i \qquad (1)$$

With $\bar{x}$: average score, x_i : the i-th data score, and n: the total number of data (Asari, 2017). After obtaining the average score, the value was compared with the standards listed in Table 2.

Table 2. TPACK Competency Criteria (Srinadi, 2015)

Value Range	Criteria
4.51 – 5.00	Very high
3.51 – 4.50	High
2.51 – 3.50	Medium
1.51 – 2.50	Low
1.00 – 1.50	Very low

RESULTS AND DISCUSSION

The study to evaluate the TPACK competence of vocational school teachers was carried out by implementing a self-report measure method in the form of a survey. This method was selected because it suits this study context and the method most studies implement in measuring TPACK (Hidayat, et.al., 2018; Oh, et.al., 2015). The TPACK competency measurement was based on its components, namely TK, PK, CK, TCK, PCK, TPK and TPACK. Furthermore, the seven components were divided into 15 indicators and 48 statement items. A detailed description of the TPACK competencies was described in the following section.

1. Technological Knowledge (TK)

TK is a suitable knowledge to use and study available technology (Sukiyasa & Sukoco, 2013). TK is divided into two indicators and its competence description of the Vocational High School teachers is listed in Table 3.

Table 3. Description of TK Data

No.	Indicator	Average Score	Category
1	Understanding of technology in learning	3.81	high
2	Ability to use technology	3.36	medium

	Average Technological Knowledge	3.58	high

Based on the data in Table 3, the indicator of understanding technology in learning had an average value of 3.81, belonging in the high category. The indicator of the ability to use technology had an average value of 3.36 (medium category). Furthermore, the average TK score was 3.58 (high category). Based on these data, the competence of teachers TPACK for the TK component was in the high category. However, the ability to use technology is an indicator that still requires attention. This condition is in line with the fact that teachers still lack the understanding in integrating technology (Cook & Artino, 2016).

2. Pedagogical Knowledge (PK)

PK refers to knowledge of teaching strategies and methods including knowledge of classroom management, development of lesson plans, preparation of learning media, and learning evaluation (Candralaela, et.al., 2018). The PK component is divided into three indicators and its competence description of the Vocational High School teachers is listed in Table 4.

Table 4. Description of PK Data

No	Indicator	Average Score	Category
1	Knowledge of learning plan development procedures	3.82	High
2	Knowledge of learning methods	3.75	High
3	Knowledge of procedures for compiling learning media	3.75	High
	Average Pedagogical Knowledge	3.77	High

Based on the data in Table 4, the knowledge indicator of learning plan preparation procedures had an average of 3.82 and falls in the high category. The learning method knowledge indicator had an average of 3.75 (high category). The indicator of knowledge of instructional media preparation procedures had an average of 3.75 (high category). Furthermore, the average PK was 3.77 (high category). Therefore, it can be concluded that the TPACK competence of teachers for the Pedagogical Knowledge component was in the high category. This is because most of the teachers that graduated from undergraduate education have studied pedagogical competencies.

3. Content Knowledge (CK)

CK is knowledge about content or subject matter that should be learned by teachers and taught to students (Siregar & Nara, 2013). It is knowledge of concepts, theories, ideas, frameworks, evidentiary knowledge, as well as practices and approaches to develop this knowledge (Wahyu, et.al., 2017). The CK component is divided into two indicators and its competence description of the Vocational High School teachers is listed in Table 5.

Table 5. Description of CK Data

No	Indicator	Average Score	Category
1	Knowledge of subject matter development strategies	3.86	High
2	Knowledge of subject matter	3.83	High
	Average Content Knowledge	3.84	High

Based on the data in Table 5, the indicator of learning material development strategy had an average of 3.86 (high category). The indicator of learning material knowledge had an average of 3.83 (high category). Furthermore, the average CK was 3.84, which falls in the high category. Therefore, it can be concluded that the TPACK competence of teachers in the CK component was in the high category.

4. Technological Content Knowledge (TCK)

The TCK is teachers' knowledge about how technology provides a way of learning representation of certain content (Magfirah, et.al., 2015). The Technological Content Knowledge dimension is divided into 3 indicators and its competence description of the Vocational High School teachers was listed in Table 6.

Table 6. Description of TCK Data

No	Indicator	Average Score	Category
1	Knowledge of subject matter that requires technology	3.72	High
2	Integration of technology-based subject matter	3.69	High
3	Implementation of the learning process using technology	3.37	Medium
	Average Technological Content Knowledge	3.59	High

Based on the data in Table 6, the indicator of knowledge about subject matter that requires technology had an average of 3.72 (high category). The indicator for integrating technology-based subject matter had an average of 3.69 (high category). The indicator of the implementation of the learning process using technology had an average of 3.37 (medium category). Furthermore, the average TCK was 3.59 (high category). Therefore, it can be concluded that the competence of the TPACK of teachers for the TCK component was in the high category. The indicators that fall in the medium category were due to the implementation of technology in the learning process which requires attention to be improved.

5. Pedagogical Content Knowledge (PCK)

The PCK is an idea that arises from the belief that teaching requires more than just to impart knowledge about the material to students and students learn not only to absorb information but also on how to apply it. PCK is the knowledge of teacher that develops continuously through

experience on how to specifically teach certain materials to achieve students' understanding [40]. The PCK component is divided into two indicators and its competence description of the Vocational High School teachers is listed in Table 7.

Table 7. Description of PCK Data

No	Indicator	Average Score	Category
1	Evaluation of student learning outcomes according to the subject matter (PCK1)	3.75	High
2	Implementation of learning according to the subject matter (PCK2)	3.59	High
	Average Pedagogical Content Knowledge	3.67	High

Based on the data in Table 7, the indicators for evaluating student learning outcomes according to the subject matter had an average of 3.75, within the high category. The indicator of learning implementation according to the subject matter had an average of 3.59 (high category). Furthermore, the average PCK was 3.67 (high category). Therefore, it can be concluded that the TPACK competence of teachers for the PCK component was in the high category.

6. Technological Pedagogical Knowledge (TPK)

TPK is the knowledge that can be used in learning and understanding that using certain technology products change the way teachers teach in the classroom (Lestari, 2015; Siagian, 2015). The TPK component is divided into two indicators and its competence description of the Vocational High School teachers is listed in Table 8.

Table 8. Description of TPK Data

Num	Indicator	Average Score	Category
1	The ability to select technology following the implemented learning strategy	3.69	High
2	Ability to facilitate students using technology to discover information independently	3.68	High
	Average Technological Pedagogical Knowledge	3.68	High

Based on the data in Table 8, the indicator of the ability to select technology that is following the learning strategy implemented had an average of 3.69 (high category). The indicator of the ability to facilitate students using technology to discover information independently had an average of 3.68 (high category). Furthermore, the average TPK was 3.68 (high category). Therefore, it can be concluded that the TPACK competence of teachers in the TPK component was in the high category.

7. Technological Pedagogical Content Knowledge (TPACK)

The TPACK concept is emphasized by the importance of a teacher to deeply understand the content knowledge, determining appropriate instructional actions (pedagogical knowledge),

utilizing the right technology in planning active learning (technological knowledge), and how to integrate these three aspects in learning (Khan, et.al, 2012). Furthermore, the TPCK components are divided into one indicator and its competence description of the Vocational High School Teachers printed in Table 9.

Table 9. Description of TPCK Data

No	Indicator	Average score	Category
1	The strategy of combining content, technology and teaching approach	3.63	High
	Average Technological Pedagogical Content Knowledge	3.63	High

Based on the data in Table 9, the strategy indicator combining content, technology and teaching approach had an average of 3.63, which falls in the high category. Furthermore, the average TPCK was 3.63 (high category). Therefore, it can be concluded that the TPACK competence of teachers is in the high category.

Teachers' knowledge to integrate technology in learning makes learning effective and efficient. Technology integration is considered a closely related component of teaching and is included in PCK (Sundayana, 2015). Another study states that the integration of TPACK is considered capable of improving student learning abilities. However, this is not always achieved due to the lack of productive implementation capabilities of technological knowledge in the teaching and learning process by teachers (Winarto, et.al., 2019). The description of the TPACK competence of vocational teachers for each TPACK component is shown in the following graph.

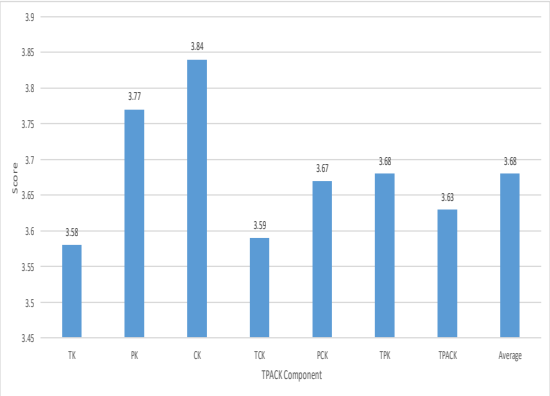

Figure 3. TPACK Component Average

Based on Figure 2, the highest score was the Content Knowledge component with an average of 3.84, indicating that the teachers had the highest competence in knowledge of subject matter content. Meanwhile, the lowest score was in the Technological Knowledge component which had an average of 3.58. This indicated that there are still teachers that have not been able to understand and apply technology in learning. This is in line with the opinion which states that most of the professional development for teachers have not supported and developed the identity

of educators as good users of advanced technology (Janssen & Lazonder, 2015). Solutions, methods and strategies are needed to overcome these problems in improving, enhancing and developing the ability to integrate technology by teachers that cannot be separated from TPACK content and pedagogic knowledge (Candralaela, 2018).

CONCLUSION

Generally, the competence of the Vocational High School teachers TPACK was in the high category. All components of TPACK including TK, CK, PK, PCK, TPK, TCK, and TPACK were also in the high category. Furthermore, the maximum score was achieved in the Content Knowledge component with an average of 3.84. Based on these data, the Vocational High School teachers had the highest competence in knowledge of subject matter content. Meanwhile, the minimum score was in the Technological Knowledge component which had an average of 3.58. The indicators that still require attention are the ability to use technology which had an average of 3.36 with medium category and the implementation of the learning process using technology which had an average of 3.37 with medium category. Both indicators require efforts to be improved through training activities related to the integration of technology in learning activities.

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