Using TPACK to Map Teaching and Learning Skills for Vocational High School Teacher Candidates in Indonesia

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Abstract—**Technological Pedagogical and Content Knowledge (TPACK) of teacher candidates for vocational high school is essential to follow the development of industrial revolution 4.0. A teacher is not only to be prepared to have content knowledge and pedagogy, but they also need to collaborate on technologies in their teaching and learning later. All of them need to be integrated to provide an impact on the optimization of teaching and learning outcomes. Therefore, this research was conducted to determine TPACK condition and to map it by its data collection using survey research method with a quantitative approach. The data were analyzed using descriptive statistics. The result showed that generally prospective vocational high school teachers have moderate TPACK. Teacher candidates' educational courses need to be developed based on TPACK condition and its implementation to improve their skills so they will be able to use technologies to maximize in their teaching and learning to follow industrial revolution 4.0.**

Keywords—*TPACK; vocational high school; teachers; learning technology*

I. INTRODUCTION

In order to face the Industrial Revolution 4.0, Indonesia as one of the developing countries needs to prepare various things, including preparing the ability of vocational secondary educational teachers [1,2]. They do not only prepared to understand the content and pedagogic abilities, but they also need to be prepared for understanding the technology. Three main elements interdisciplinary that form a unit elements known as TPACK (Technological Pedagogical and Content Knowledge) [3-5] as shown in figure 1. This is an important component to follow industrial revolution 4.0 for teacher candidates for vocational high school [6-7].
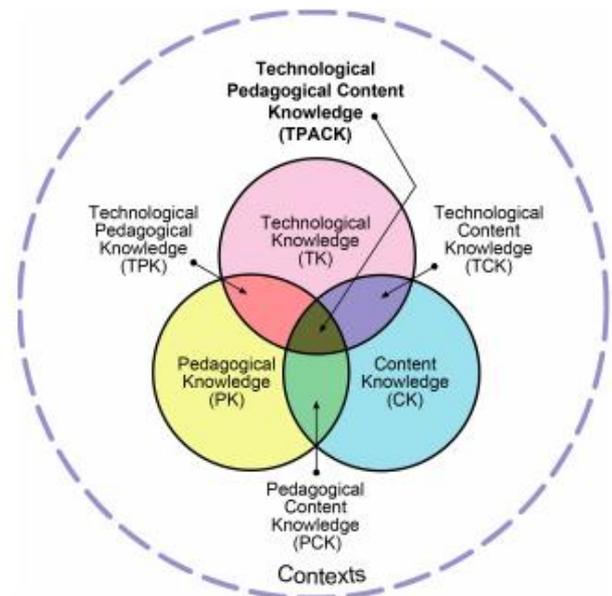

Fig. 1. The TPACK framework and its elements [8].

TPACK teacher candidates have seven elements (see figure 1). They are content knowledge (CK), pedagogic knowledge (PK), technological knowledge (TK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and TPACK. Three main elements of teacher candidates' knowledge are content, pedagogy, and technology. PCK is how to choose teaching strategies allow students to meet the skill and content objectives [9]. TCK is how the use of this technology as the most effective tool to teach the content and skills for students [8]. TPK is how to choose the best technological tool to become a teaching strategy [10].

The TPACK elements are related to the ability of prospective teachers to conduct teaching and learning professionally in the era of industry 4.0 so that this can be used to map teaching and learning skills for vocational high school candidates in Indonesia. Furthermore, the purpose of this research is to determine TPACK condition and how to map it.

II. METHODS

This study used a descriptive method with a quantitative approach. The population were students as teacher candidates in the Faculty of Engineering in the State University of Malang implemented School Internship Program with 762 students. While, 200 respondents were chosen as research sample with stratified random sampling. The data collection used online questionnaire, interview, and documents. Then, data were analyzed with descriptive statistics.

III. RESULTS AND DISCUSSION

This section is divided into two parts: TPACK condition of teacher candidates for vocational high schools and the map of TPACK for teacher candidates for vocational high schools. Furthermore, the explanations are as follows.

A. TPACK Condition of Teacher-Candidates for Vocational High Schools

Based on the results of data analysis, the condition of TPACK teacher candidates for vocational secondary schools can be seen in table 1.

TABLE I. TPACK CATEGORY OF TEACHER CANDIDATES FOR VOCATIONAL HIGH SCHOOLS AT THE STATE UNIVERSITY OF MALANG

Elements	Mean	Category
Technological Knowledge (TK)	15.66	Good
Pedagogical Knowledge (PK)	20.04	Moderate
Content Knowledge (CK)	13.18	Good
Technological Content Knowledge (TCK)	19.69	Very good
Pedagogical Content Knowledge (PCK)	17.22	Good
Technological Pedagogical Knowledge (TPK)	19.92	Good
Technological Pedagogical Content Knowledge (TPACK)	15.15	Moderate

Table 1 showed that the TCK element was very well categorized and TK, CK, PCK, and TPK were a good category. While PK and TPACK were the moderate categories. This condition was consistent with the document data which stated that pedagogic material was taught by lecturers who were not graduates of vocational education and have not experience in teaching and learning vocational education and industries.

Prospective vocational high school teachers said that they did not understand how to teach students in vocational high schools properly and effectively. They feel weak in analyzing the learning situation and conditions in the classroom so that it is only done to complete their study criteria that are their duty. They have not thought about doing quality teaching and learning so that this will have a significant impact on learning outcomes.

Some things affecting this condition is institution policies in the levels of university, faculty, and departments, political issues, leadership styles, traditional culture, not human resources in the right jobs, and programs that are supported by guidelines clearly and simply. This because the existing resources are not ready to accept changes in the industrial era 4.0.

B. The Map of TPACK for Teacher-Candidates of Vocational High Schools

In order to map the TPACK for teacher-candidates of Vocational High School in the prospective teachers' education, the State University of Malang needs to develop a model for the setting of teacher candidates' educational curriculum integrating elements of TPACK as in table 2.

TABLE II. THE MODEL OF TPACK-BASED CURRICULUM

TPACK					
TK	PK	CK	TCK	PCK	TPK
- Educational technological courses - Courses' experiences for content-specific - Courses' experiences for teaching methods - Longitudinal and integrated coursework studies					
- School internship program					

The integration of TPACK-based curriculum designed as in table 2 divides the subjects into five groups: Educational technological courses, courses 'experiences for content-specific, courses' experiences for teaching methods, longitudinal and integrated coursework studies, and school internship programs. The aim is to provide experience to prospective teachers related to the three main elements of TPACK: content, pedagogic, and technology. In addition, this was formed to integrate cooperative networks with the teacher, school and industry communities.

Furthermore, to implement it, this was not only planned, but the authors also designed the concept of the development system model. This model is called The Model of MPDCA (Map, Plan, Do, Check, and Action) cycle for preparing TPACK teacher candidates for Vocational High School in the era of Industrial Revolution 4.0. This model is illustrated as figure 2.
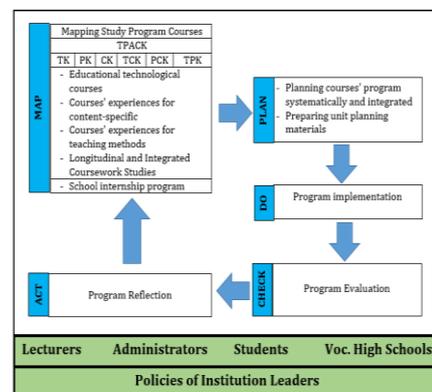

Fig. 2. The Model of MPDCA cycle for preparing TPACK teacher-candidates of Vocational High School.

Figure 2 showed that the first process maps the courses of the study program (MAP). Second is planning (PLAN). This activity plans lectures in a systematic and integrated manner and prepares unit planning materials. The third step implements the planning (DO). The fourth step is the evaluation (CHECK). This stage is carried out to evaluate the program carried out so that the effectiveness of the program can be measured. The last stage is refection (ACT). This is conducted to reflect the overall stages to make the better mapping. Everything was done with the support of the entire academic community of the institution consisting of lecturers, administrations, students, and vocational high schools. While as a foundation, the policy of institutional leadership is very necessary.

IV. Conclusions

For preparing TPACK teacher-candidates for Vocational High School, there needs several thigs including policies from institutional leaders, collaboration among leaders, lecturers, administrators, students, and schools, the concept map based on the sustainable and integrated development, the guideline clearly and simply, and supported by the Technological system in industry 4.0. In the other hand, human resources should work based on their competencies that always up dated. The purpose is that they will easy to give each changes in the era of industrial revolution 4.0.

References

[1] A. Ziderman, "National Programmes in Technical and Vocational Education: Economic and education relationships 1," J. of Voc.Edu. & Tr., vol. 49, no. 3, 1997.

[2] Y. Estriyanto, S. Kersten, P. Pardjono, and H. Sofyan, "The Missing Productive Vocational High School Teacher Competency Standard in the Indonesian Education System," J. of Tech. Edu. and Tr., vol. 9, no. 1, 2017.

[3] M.J. Koehler, P. Mishra, and W. Cain, "What is Technological Pedagogical Content Knowledge (TPACK)?" J. of Edu., vol. 193, no. 3, 2013.

[4] F. Pusparini, R. Riandi, and S. Sriyati, "Developing Technological Pedagogical Content Knowledge (TPACK) in Animal Physiology," J. of Physics: Conf. Series, vol. 895, no. 1, 2017.

[5] L.N. Margaret, G.-W. Henry, eds. Handbook of Research on Teacher Education in the Digital Age (2 Volumes). IGI Global, Hershey, USA, 2015.

[6] M. Hofer and N. Grandgenett, "TPACK Development in Teacher Education: A Longitudinal Study of Preservice Teachers in a Secondary MA Ed. Program, J. of Res. on Tech. in Edu., vol. 45, no. 1, (2012)

[7] M. Bower, Design of Technology-Enhanced Learning (Emerald Publishing Limited, Britania Raya, 2017.

[8] M. Koehler and P. Mishra, "What is Technological Pedagogical Content Knowledge (TPACK)?," Contemporary Issues in Tech. and Teacher Edu., vol. 9, no. 1, 2009.

[9] S. Magnusson, J. Krajcik, and H. Borko, Examining pedagogical content knowledge. Springer: Dordrecht, 1999.

[10] A. Tanak, "Designing TPACK-based course for preparing student teachers to teach science with technological pedagogical content knowledge," Kasetsart J. of Soc. Sci., vol. xxx, pp. 1-7, 2018.