Developing Learning Media Application for Industrial Automation through TPACK Approach (Technological, Pedagogical, and Content Knowledge)

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Abstract. The research was carried out at schools with the following stages of implementation: (1) at the beginning of the face-to-face learning, students were given an introduction to technology in responding to their basic industrial automation skills, (2) demonstrations and presentations of Learning Media Applications for Industrial Automation through the TPACK approach, (3) trials of Learning Media Applications for Industrial Automation that have been made. From the results, it is obtained that the design of Industrial Automation learning media applications through the TPACK approach encourage students to explore the concept of industrial automation more deeply. The performance of learning media application for Industrial Automation is successfully done. In addition, the level of students' understanding shows that the application of Industrial Automation learning media provides significant benefits based on the results of variable testing. Previously, it was difficult for students to understand the concepts of technology and industrial automation. After learning with Industrial Automation application media, students more easily understand the concepts of technology and industrial automation.

Key words: Applications, learning media, TPACK, Media Applications.

Introduction

In the transition era from the industrial revolution 4.0 to society 5.0 (Xu et al., 2021: 530-535), most of life's aspects are directed to digital technology in order to be able to solve various challenges and social problems by utilizing various innovations that were emerged in the era of the industrial revolution 4.0 (Taar & Palojoki, 2022). To answer the challenges of the industrial revolution 4.0 and society 5.0 in the world of education, 21st century life skills or better known as 4C (Creativity, Critical Thinking, Communication, Collaboration) are needed. The world of education is required to construct learning that involves technology, which previously focused on information from books and tended to focus on local or national areas (Li et al., 2022; Hennessy et al., 2022). However, learning process today is obtained from various sources and technology & information platforms and curriculum developments globally. In Indonesia, it is interpreted as independent learning (Mishra & Warr, 2021). TPACK (Technological Pedagogical Content Knowledge) is a framework for integrating appropriate pedagogical technology to explain content (Santos & Castro, 2021; Wardoyo et al., 2021). TPACK can be a basis for developing effective learning media to teach material and can make students more active in following lessons in class. Several learning models that have been popularly used as a result of TPACK-based development include blended learning by combining face-to-face learning with online learning (Schmid et al., 2021). For online purposes, a teacher can take advantage of this application. The purpose of this study is to develop an industrial automation learning media application through TPACK approach to support the learning

process of Industrial Automation at school (Nursamsu & Kusnafizal, 2017; Goyal et al., 2022; Meirovitz et al., 2022).

Research Method

The research was carried out at schools with the following stages of implementation (Hosseini, 2015: 98-103):

(1) at the beginning of the face-to-face learning, students were given an introduction to technology in responding to their basic industrial automation skills;

(2) demonstrations and presentations of Learning Media Applications for Industrial Automation through the TPACK (Technological, Pedagogical, and Content Knowledge) approach;

(3) trials of Learning Media Applications for Industrial Automation that have been made;

(4) distributing questionnaires to determine the behavior of students and teachers in all learning activities;

(5) assessing the results of the Learning Media Applications for Industrial Automation made and testing students' abilities (Fuhrländer-Völker et al., 2021; Chaipidech et al., 2022).

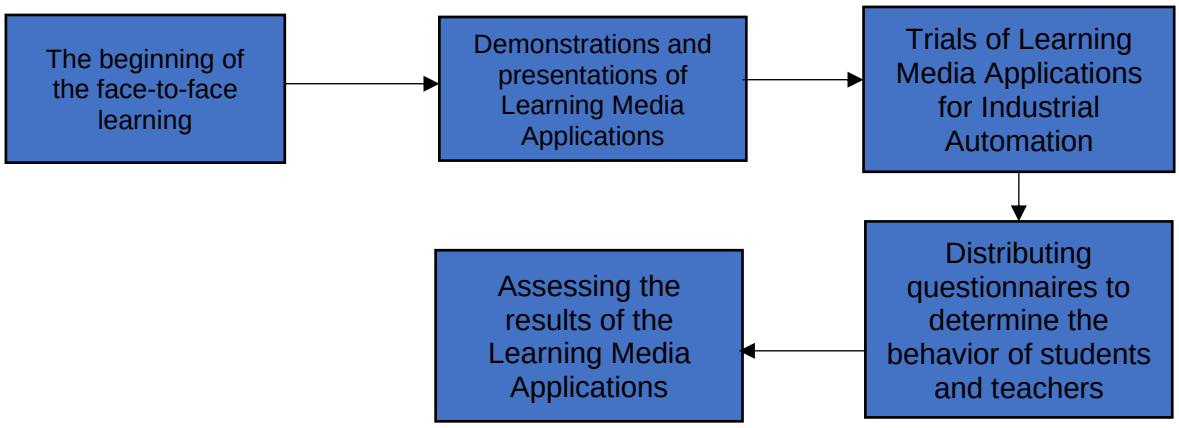

Fig. 1. Research Learning Implementation Media Applications. Source: Ning (2022)

Results

Based on the results of research on Developing Industrial Automation Learning Media Applications Through the TPACK (Technological, Pedagogical, and Content Knowledge) approach in the introduction of industrial automation learning media using portable boiler machines in several vocational schools in Karawang Regency, according to the teachers, when it is applied and implemented, it can be very effective to help students. Especially in mechanical engineering, electronic engineering, and electrical vocational programs as an Application of Industrial Automation Learning Media Using Portable Boiler Machines, especially in some subjects including workshop engineering, industrial automation, basic electronics engineering, electronic circuits, control system engineering, and digital simulation.

The division of groups in the study used the TPACK (Technological, Pedagogical, and Content Knowledge) approach through technological learning and knowledge using the application content of the Industrial Automation Learning Media Application given after students were previously distributed into several groups according to the number of students. The division of groups is done alphabetically according to the arrangement of

the attendance list. It means that the result is significant to accept H0, which is that students' understanding of electronics before and after training increases.


Fig. 2. Testing specifications of Industrial Automation Learning Media Applications

Table 1. Test Results of Research Variable

Variable	Score	Status
Students' knowledge and skills in operating industrial automation learning media using a portable boiler machine based on a digital monitoring system	95	Available
Media hardware learning for Industrial Automation Using a Portable Boiler Machine Based on a Digital Monitoring System	96	On
Industrial Automation learning media software Using a Portable Boiler Machine Based on a Digital Monitoring System	85	Error


Fig. 3. Implementation of learning in the classroom with the TPACK approach

The program for this digital monitoring system-based industrial automation learning media application is made in Python and C language and uses MIT App Inventor and CodeVision AVR software as well as Arduino programming. To complete the program, several facilities are used in the Arduino microcontroller, including the timer, ADC and LCD as well as the internet of things. The program structure contains the menu-setting program, controlling the temperature and pressure values of the portable boiler machine, and controlling the ADC value.

Discussion

This research is relevant to the research conducted regarding TPACK Competency Analysis in High School Biology Teacher Learning Media. The similarity of their research with this research is in the approach used in their research, namely TPACK, while the difference is in the learning media used by researchers. This research is also relevant to the research conducted by Nursamsu & Kusnafizal in 2017 regarding the Implementation of ICT-Based Learning (Information and Communication Technology) as a Multimedia Computer Tool to Improve Teacher Competence and Student Achievement. The similarity of their research with this research is the use of computer-based and online media applications as well as the research objectives, while the difference lies in the research method and approach that does not use TPACK.

Conclusion

From the research results and based on the application of learning and the performance of this industrial automation learning media application, it is concluded that the application can work well according to its function. In the measurement results of several parts of the system, there are some differences in the measurement results from what has been obtained from the theory or component datasheets on the application of automation learning media. However, these differences do not cause disruption to the performance of industrial automation learning media applications. The difference in these results occurs because there are several factors including delay in application programming, tolerance of component values from the factory, and human error in operating industrial automation learning media applications. With the TPACK approach, which emphasizes knowledge of technology and application content, as well as a pedagogic approach to students, it has a positive impact on increasing knowledge about industrial automation.

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