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Implementation of IoT-based practicum learning media for vocational students in the 4.0 era

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ABSTRACT

This study aims to determine the implementation of the use of Internet of Things (IoT)-Based Automation Control Systems as a practical learning medium for students of SMK Negeri 3 Sidrap Competence in the Field of Plant Agribusiness and Horticulture. The sample of this study was class X students of Agribusiness Food Crops and Horticulture SMK Negeri 3 Sidrap, drawn using total sampling technique. Data collection techniques are direct observation of the activity process and observations made by teachers during practicum activities. The data analysis technique used is quantitative descriptive analysis by looking at the percentage of success of practicum implementation. Based on the results of the study, it can be seen that the implementation of the practice of soil temperature and moisture measurement subjects can be carried out well, as the results of observations on the implementation of activities reach a percentage of 100% and the results of observations using Internet of Things (IoT)-based Automation Control System media in practical learning by 100%. Thus, it can be concluded that the implementation of practicum can be done by implementing Internet of Things (IoT)-based Automation Control System media.

Keywords:

IoT,
Practicum,
Learning media,
Vocational,
4.0 era

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Introduction

Currently, the world has experienced a major production evolution, entering the era of the industrial revolution 4.0 which was marked by increased connectivity, machine interaction, and other resources. Various objects can be connected to the Internet thereby creating significant changes in the information-based economy and education. Information flows will play an important role in the Information Technology ecosystem in the future (Chegini et al., 2021). This is happening in all lines or sectors, be it the economic, cultural, health, or education sectors, all of which are now inseparable from information and communication technology. Changes in this era cannot be avoided by anyone, so it is necessary to prepare adequate human resources so that they are ready to adapt and be able to compete on a global scale (Nilasari, 2020), (Lince, 2022) because the development of science and technology in the industrial era 4.0 has made what a breakthrough for some people.

The development of science and technology has resulted in some people taking advantage of opportunities and being able to make good use of them (Astuti et al., 2019), so that they are very influential in various aspects of human life, both in the fields of economics, politics, culture, art, and education. Education is the most important sector for the development of human resources (Satria, 2023) because education is one of the instruments needed to overcome human backwardness in

science against poverty. Education can increase the reasoning capacity of everyone to learn new knowledge and skills (Mustaqim & Wahib, 1991), thus making them productive human beings. The process of teaching and learning activities is deemed necessary for students to be able to receive the knowledge conveyed by educators by identifying learning outcomes that have been received by students and understanding them. The use of science and technology allows us to create artificial intelligence which when combined with the Internet of Things (IoT) will be able to process millions of data (big data) into a decision or conclusion (Sabri, 2019).

The Internet of Things (IoT) is a technological revolution that represents the future of computers and communications, where its development depends on the dynamics of technological innovation in various fields, from wireless sensors to nanotechnology (Bakri, 2016). IoT creates a smart environment for humans (Luthfiandari, 2022). IoT is a network system or electronic device that is interconnected, where connectivity can provide data exchange services with other devices, formed from a computing system that can operate within the Internet network infrastructure (Muchlis et al., 2018). In the world of education, IoT is a system that makes it possible to increase convenience in the teaching and learning process (Hardyanto, 2017a), (Sudirman, 2021).

To improve the quality of student learning processes and outcomes, quality human resources are needed (Akbarjono, 2022b). learning facilities effectively and efficiently (Mulyasa, 2020). Law Number 14 of 2005 concerning teachers and lecturers, states that every teacher must be able to utilize technology for the benefit of organizing educational development activities (Law No.14 of 2005) (Indonesia, 2005). Teachers must be technologically literate so that in teaching they can use various technologies as media or learning resources (Rahadian, 2017), (Astini, 2019). The Ministry of Education and Culture is committed to providing support so that the dream of transforming the world of education, especially schools in the country, can be realized. One that will be transformed is the Vocational High School.

Vocational High School (SMK) is a secondary education institution that organizes a three-year educational program after Junior High School (SMP), with the expected result that students are ready to enter the world of work after graduating from school (Putriani et al., 2020), (Hambali, 2019), (Kreisman & Stange, 2020). The implementation of SMK needs to be designed to equip students with the skills needed by the market (Nurmayanti & Ferdiansyah, 2021), bearing in mind that currently SMK graduates still find it difficult to answer the challenges of the Business and Industrial World (DUDI). To achieve the goal of creating SMK graduates, a special program has been prepared for SMKs, namely the Center for Excellence Vocational School Program (Sholihatinnisa et al., 2021). Learning activities in Vocational High Schools, where most of them are practicums, must be supported with the right media (Pardosi, 2022). For this reason, the role of technology, in this case, an IoT-based Automation Control System as a practical learning medium, is urgently needed to support learning outcomes.

Method

This research is included in the quantitative descriptive research with the type of descriptive survey research (descriptive survey). The population used in this study were class X students of Plant Agribusiness and Horticulture Competence at SMK Negeri 3 Sidrap 12. The research sample was taken from a population of 12 people. The sampling technique in this study is total sampling. Total sampling is a sampling technique where the number of samples is the same as the population (Sugiyono, 2017). Total sampling because the total population is less than 100 and the entire population is used as the research sample. Data collection was carried out at SMK Negeri 3 Sidenreng Rappang, Sidenreng Rappang Regency in 2022. The data collection technique used in this study was a participatory observation technique, in which researchers participated by observing the implementation of practicum activities using an Internet of Things (IoT)-based Automation Control System as a medium practicum learning for SMK 3 Sidenreng Rappang students, questionnaires and documentation.

Observation is a data collection activity through observing ongoing activities (Sukmadinata, 2009). Observations were made to see the success or failure of the entire series of practicum activities and to see the benefits of an Internet of Things (IoT) Based Automation Control System in supporting the implementation of practicum activities at State Vocational High School 3 Sidrap Competency in Agribusiness Food Crops and Horticulture. A questionnaire is a data collection technique in which participants or respondents fill out questions or statements and then, after filling them in completely, return them to the researcher (Permata & Bhakti, 2020). Documentation in a broader sense is in the form of an evidentiary process based on any type of source, whether written, oral, illustrated, or archaeological (Nilamsari, 2014). Documentation is carried out to see a series of practicum activities from the preparatory stage to the end of the practicum.

The questionnaire in this study was presented in such a way that respondents could check the appropriate column or place. The questionnaire in this study was given to teachers to measure the effectiveness of implementing practical learning using an Internet Of Things (IoT) Based Automated Control System, as well as to students to find out the response to using an Internet Of Things (IoT) Based Automated Control System in practical activities for measuring water content in soil. The data analysis technique of this research is the descriptive quantitative analysis technique. The results of the quantitative data from the answers to the questionnaire were analyzed descriptively using the percentage technique. The steps taken in using this data analysis technique are as follows: 1) Make a distribution table for the answers to the questionnaire; 2) Determine the score of the respondent's answer according to the predetermined score; 3) Calculating the percentage of the effectiveness of using the Internet Of Things (IoT) Based Automation Control System in practical implementation. The formula used is as follows:

$$Percentage = \frac{\sum x}{SMI} \times 100$$

Informasi:

$\sum x$ = Total score

SMI = Ideal Maximum Score (Ferdiansyah et al., 2021)

Results and Discussion

The results obtained in this study are an overview of the results of practicum activities for measuring soil moisture levels carried out by subject teachers and students at SMK Negeri 3 Sidenreng Rappang on the subject of measuring soil temperature and moisture. Next, the subject teacher fills out an observation sheet on the successful implementation of the practicum carried out using an Internet of Things (IoT)-based Automation Control System. Practicum activities using an Internet of Things (IoT)-based Automation Control System are carried out to see and know the entire series of practicum activities starting from the preparation, implementation, and results stages, work attitude, and practicum working time. The practicum is carried out by utilizing an Internet of Things (IoT)-based Automation Control System. Practical implementation of measuring water content in soil requires NCU Nodes, humidity sensors, Arduino relays, LCDs, and water pumps to be assembled so that they become practical learning media.



Figure 1. MCU nodes

Node MCU is a circuit board powered by the ESP8266 chip that can connect to the internet and perform microcontroller (WiFi) operations. To create monitoring and control applications for IoT projects, there are several I/O pins.

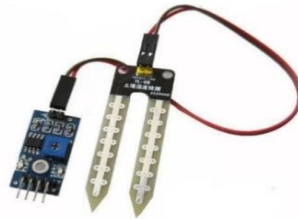


Figure 2. Soil Moisture Sensor (YL Sensor)

A specific type of sensor that measures soil moisture by detecting the wetness around the soil.



Figure 3. Arduino relays

A relay is an external device that can be used as a switch or switch for other devices. The relay is controlled by the voltage from the Arduino pin so it can make a switch. There are 3 main connections, namely COM for input from other devices. NC (Normally Close) under normal circumstances com will be connected to the NC pin.

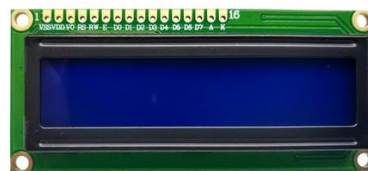


Figure 4. LCDs

The purpose of the LCD is to display data, letters, characters, or images. This LCD has good resolution, is thin, and runs a little warm. Especially in electronic products such as TV screens, mobile phones, laptops, PCs, and notebooks, LCDs have been used in various industries.



Figure 5. Water pump

A water pump is a machine that takes water from a low level to a high level to circulate water from the ground to all the taps in the house.

Furthermore, there is a smartphone or laptop to access soil moisture levels via internet access. However, to create an Internet of Things (IoT)-based Automation Control System learning media, a Cloud Server learning media is also needed which will store all files and data so that it can be accessed by everyone via the internet, as well as a qualified internet connection. To access practicum content on computers or smartphones, teachers and students can be accessed at <http://media.Televisium-accs.my.id/>



Figure 6. Smartphones and Laptops



Figure 7. Internet Of Things (IoT)-based Automation Control System Display

Figure 7 shows the display of time and display of moisture levels in the soil which were measured during the practicum process for SMK 3 Sidrap students.



Figure 8. Internet of Things (IoT) based Automation Control System learning media display

After the practicum learning takes place, students are directed to immediately complete the activity following the steps in the practicum LKS, then the educator, in this case, the teacher, evaluates, namely doing the exercises that have been given before. In addition to direct observations made during practicum activities, the teacher also fills out observation sheets for practicum implementation and observation sheets for the use of Internet of Things (IoT)-based Automation Control System learning media. The observation sheet instrument for practicum implementation is shown in Table 1 and the observation sheet instrument for the use of Internet of Things (IoT)-based Automation Control System learning media in practicum implementation can be seen in Table 2.

Table 1. Observation Practicum Implementation Instrument

Phase	Step	Implemented (1)	Do not (0)
Preparation	a. Teachers prepare practicum implementation	√	
	b. Teachers wear laboratory coats, gloves, and masks during chemistry practicum	√	
	c. Teachers and students prepare practical tools	√	
	d. Teachers and students prepare practical materials	√	
	e. The teacher gives instructions for the use of practical tools	√	
	f. The teacher gives instructions for the practical use of the material	√	
	g. Teachers are able to convey direction (occupational safety and health)	√	
	h. The teacher gives students the opportunity to ask questions about the instructions that have been delivered	√	
	i. The teacher explains the purpose of the practicum to the students	√	
	j. Teachers motivate students	√	
	k. The teacher provides Student Worksheets (LKS) as a practical guide	√	
	Amount	11	
Implementation	a. Teachers start practicum activities on time	√	
	b. Students use pre-prepared tools	√	
	c. Students use prepared materials	√	
	d. Students carry out practicum activities, such as:	√	
	1. Observe	√	
	2. Collecting data	√	
	3. Practice	√	
	4. Work on practice worksheets	√	
	5. Summarizing practicum results	√	
	e. The teacher makes observations to assess the implementation of student practicum	√	
	f. The teacher ends the practicum on time	√	

Phase	Step	Implemented (1)	Do not (0)
	Amount	11	
Closing	a. The teacher asks students to collect practicum worksheets that have been done	√	
	b. Teachers and students discuss problems that occur during practicum	√	
	c. Teachers and students jointly collect data to solve problems	√	
	d. Teachers and students conclude practicum activities	√	
	e. The teacher instructs students to make a report	√	
	f. Teachers give objective assessments	√	
	g. The teacher returns the results of the practicum accompanied by providing feedback that educates and motivates the learners	√	
	h. Teachers give praise / appreciation to students who successfully carry out practicum well	√	
	Amount	8	
Total			30

Based on table 1 which contains statements about the implementation of the practicum carried out, is divided into three stages, namely the preparation stage, the implementation stage, and the closing stage. Assessment of the instrument using a dichotomous scale (dichotomous scale). The dichotomous scale is used to get answers in the form of Yes or No so that each statement item is given a score of 1 (one) if it is implemented and given a score of zero (0) if it is not or has not been implemented. In the preparation stage, which consisted of eleven items, the statement received a score of eleven. Likewise, for the implementation phase which consisted of eleven statement items, a score of eleven was obtained, and the closing stage which consisted of eight statements received a score of eight. Cumulatively, getting a score of 30 for all stages of implementation gets a percentage of 100%, which means that all stages of practicum implementation can be carried out properly when using the Internet of Things (IoT)-based Automation Control System learning media.

Table 2. Use Internet of Things (IoT)-based Automation Control System Observation Instruments

Activities	Implementation	
	Succeed	It didn't work
Student activeness in expressing ideas	√	
Teachers can control students' practicum activities	√	
Teachers can correct students' mistakes directly	√	
Teachers can meet face-to-face offline	√	
Teachers can guide students directly	√	
Teachers and students know the correct soil moisture content	√	
Teachers and students know the moisture content needed by plants	√	
Teachers and students know and understand the working system of the Internet of Things (IoT)-based Automation Control System	√	
Total	6	

Based on observations of the use of an Internet of Things (IoT)-based Automation Control System in practical measurements of soil water content in Table 2, it can be stated that an Internet of Things

(IoT)-based Automated Control System can be used to support the implementation of practical learning. This can be seen from the entire statement that describes the usefulness of an Internet of Things (IoT)-based Automation Control System if it is used in practical implementation it can run well. The results of this study are in line with research conducted by (Simić et al., 2016) in (Hardyanto, 2017b) the results of the IoT being developed can help students complete projects. Charmonman (2015), researched IoT applications in e-learning, IoT applications have the potential to enhance the learning experience of students (Charmonman et al., 2015). Another research conducted by Veeramanickam (2016), regarding IoT, applied to smart campuses, resulted in Smart E-learning Applications with IOT which save costs and improve the learning process (Veeramanickam & Mohanapriya, 2016). The Internet of Things can solve problems that arise in the world of education (Sulaiman & Widarma, 2017).

Conclusion

Based on the results of the research obtained, it can be concluded that the implementation of practicum activities can be carried out properly according to procedures by utilizing Internet of Things (IoT)-based Automation Control System media in the practicum of measuring ground water content. This is evidenced by the results of observations on the implementation of practicum activities starting from the stages of preparation, implementation and results, work attitude, and implementation time which states that the entire series of activities have been carried out. In addition, it is also proven through the results of observations on the use of Internet of Things (IoT)-based Automation Control Systems in the practicum of measuring soil water content where all items can run as expected. Thus, Internet of Things (IoT)-based Automation Control System media can be used to support the implementation of practicum activities.

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