THE EFFECTIVENESS OF INTERNET OF THINGS-BASED MODULE IN IMPROVING STUDENTS' DIGITAL LITERACY

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ABSTRACT

In this era of the 4.0 technology, an improvement in the quality of Human Resources (HR) is needed, particularly in enhancing students' digital skills. One of the efforts that can be made to enhance this quality is by producing an outstanding generation through innovations in the field of education. Data obtained shows that 50% of students still have low digital literacy. Therefore, the purpose of this research is to determine the effectiveness of an Internet of Things (IoT)-based module in improving students' digital literacy. The research method used is quasi-experimental with the independent t-test technique. The research sample consists of students from class X MPLB 1 and X MPLB 2 at SMK Negeri 6 Surakarta. The data collection technique used is multiple-choice test questions. The research results show a significance value of 0.004. The test data is less than 0.05, which means that the IoT-based module developed effectively improves students' digital literacy.

KEYWORDS: Module, Internet of Things, Digital Literacy

INTRODUCTION

Education serves as a means to nurture an outstanding generation in accordance with the demands of the times. Continuous changes in the field of education are being made to ensure that the learning process can be carried out optimally. The efforts made to continually improve the learning process are known as lifelong learning [1], [2]. This type of learning can be achieved when supported by the implementation of innovations in education, starting from instructional materials, models, methods, and learning media [3].

One aspect that influences the output of Human Resources (HR) is the use of appropriate instructional materials. Instructional materials include written texts, audio visual materials, worksheets, and student exercise questions [4]. In this era of technological advancement, instructional materials must be adapted to the development of the times. Internet-based instructional materials can be used to support modern learning patterns. These instructional materials aim to enhance the quality of learning, digital literacy, and students' self-directed learning abilities [5]. Meanwhile, modules can be utilized as independent learning materials for students to build their knowledge [6].

Considering the aforementioned benefits of instructional materials, it is important to innovate in education, particularly focusing on instructional materials that emphasize the application of technology in order to improve students' digital literacy. Field observations indicate that the majority of students in X grade of the Office Management and Business Services (MPLB) program at SMK Negeri 6 Surakarta are able to access social media for leisure purposes, but only a few students are able to utilize technology to enhance their knowledge in the field of education [1], [7]. This issue needs to be addressed by teachers to enable students to access learning materials through the internet. Essentially, information related to education can be easily obtained through gadgets, providing convenience for both students and teachers [8].

Observation results also indicate that students' reading culture is very low, both in reading learning materials through books and the internet. This is evidenced by research findings in developing countries where many students do not have books to study [9]. The lack of a reading culture will impact students' low digital literacy. Therefore, it is necessary to develop modules that cater to students' needs to encourage the improvement of digital literacy. The benefits of digital literacy are not limited to easy access to technology; they also assist in the absorption of knowledge and the acquisition of necessary skills and concepts by students [10].

An Internet of Things (IoT)-based module can be used as a means of student learning to enhance digital literacy. IoT is a technology that provides various information from the internet and is known as a data-driven smart system [11], [12]. Furthermore, IoT plays a crucial role in improving students' learning experiences, supporting daily tasks, and facilitating distance learning [13]. Online or distance learning techniques can be effectively enhanced through the use of IoT. The various benefits of IoT can create an intelligent learning environment that fosters critical thinking among students in problem-solving [14]. Based on the opinions of several experts on modules and IoT, this research focuses on examining the effectiveness of implementing an Internet of Things-based module in improving students' digital literacy.

THEORETICAL BACKGROUND
Module
A module is an instructional material that is organized systematically to facilitate students in mastering the subject matter. The presented material uses language that is easily understood by students, thereby promoting self-directed learning and shaping students' knowledge [15, 6]. The role of the teacher during the learning process is as a facilitator or mentor. The teacher can provide solutions and guidance when students encounter specific problems [16].

The development of a module as a learning guide should consider the needs of students so that the learning objectives can be achieved. The alignment of learning activities with the content in the module will influence student engagement during the learning process [17]. There are six elements to consider when developing a module: consistency, format, organization, attractiveness, as well as

font style and size [18]. Attractiveness is an important factor in capturing students' attention, for example, developing a module by incorporating the use of modern technology to meet the current needs.

This statement is in line with the opinions of other researchers who argue that internet-based instructional materials can provide additional benefits, such as enhancing digital literacy. The rapid development of technology in the present era poses a challenge for educators to enable students to utilize technology for learning purposes [5]. Most students are already familiar with technology and engage in technology-related activities almost every day [19]. Therefore, module development should be accompanied by the use of technology so that students can operate technology for learning activities. This approach is also a step towards improving students' literacy [20].

Internet of Things (IoT)

The Internet of Things (IoT) is a smart system that provides easy access to various information [11, 12]. All education-related information can be accessed using IoT. Furthermore, IoT can be used by students to enhance interactions, both with teachers and among students, in order to achieve specific goals [21]. The presence of IoT in the field of education plays a crucial role in facilitating the smoothness of the learning process in schools. IoT can make teachers' and students' work more effective and efficient.

Another benefit that students gain from IoT is a more open mindset in receiving information. Students become more meticulous, analytical, and critical in evaluating the information they receive [22]. This information is not simply accepted at face value; students with an open mindset will try to solve problems within the information. In the era of Industry 4.0, an open mindset facilitates students in learning new things related to modern technology, thereby fostering digital literacy [23].

The role of IoT will bring about significant changes in the field of education. Conventional learning methods are transformed into modern and innovative learning approaches [24]. Additionally, the use of IoT promotes innovative learning. Teachers can implement e-learning or distance learning [25]. Implementing IoT among students nowadays should not be difficult as the majority of their activities depend on technology [19]. Teachers only need to guide and direct students to optimize IoT for learning activities. This aims to minimize students' misuse of technology [1].

Digital Literacy

Critical thinking skills are crucial in this era of modern technology for progress in the field of education. These skills encompass several criteria, including students' ability to think creatively, critically, analytically, and innovatively. All these aspects contribute to shaping students' digital literacy [23, 22]. The process of enhancing digital literacy needs to be maximized to ensure that individuals' skills align with technological advancements [26].

The aforementioned process goes beyond students' ability to operate technology; it also involves their capacity to process various information received and generate knowledge for themselves [1]. High levels of digital literacy among students will have an impact on the quality of Human Resources (HR) produced [27]. Therefore, the presence of technology poses a new challenge for teachers to enhance students' digital literacy skills. This aims to align students' skills with the needs of the future industrial world [28].

The success of students in improving digital literacy is also dependent on the role of a teacher. Teacher professionalism is needed to promote such improvement [29]. This statement is consistent with the opinion of experts that the education factor, particularly teachers, significantly influences students' digital literacy quality [20]. The positive impact of this improvement is the enhancement of students' digital skills. Moreover, its long-term impact includes creating opportunities and contributing to sustainable development [19].

METHODOLOGY
The type of research conducted is a quasi-experiment, comparing the digital literacy of students in two classes (the experimental class and the control class). Quasi-experimental research is used to determine differences between two or more variables [30]. The research design used is a Non-equivalent Control Group Design, comparing pre-test and post-test scores for both the experimental and control classes. The study aims to assess the effectiveness of implementing an Internet of Things (IoT) based module in improving students' digital literacy.

The sample for this research consists of Class X MPLB 1 as the experimental class and Class X MPLB 2 as the control class at SMK Negeri 6 Surakarta. The research instrument uses a questionnaire in the form of multiple-choice test items. Before conducting the study in both classes, prerequisite tests such as normality and homogeneity tests should be performed. If the obtained data are normally distributed and homogenous, the p-value should be greater than 0.05.

Once the prerequisite tests are satisfied, the effectiveness of the IoT-based module implementation can be evaluated. Effectiveness is tested using the t-test through SPSS 22. If the obtained p-value is less than 0.05, it indicates a significant difference in digital literacy between the experimental and control classes. This result demonstrates that the implementation of the IoT-based module effectively improves students' digital literacy in Class X MPLB.

RESEARCH RESULTS AND DISCUSSION
The effectiveness of implementing the IoT-based module is assessed using the t-test to determine the differences in students' digital literacy after receiving treatment using the module. If the t-test result is below 0.05, it indicates that the IoT-based module implementation effectively improves students' literacy. If the result is above 0.05, it suggests no improvement. Prior to the t-test, several prerequisite tests, such as normality and homogeneity tests, should be conducted using SPSS 22.

The research conducted at SMK Negeri 6 Surakarta used a sample of two classes, namely Class X MPLB 1 and Class X MPLB 2, with each class consisting of 36 students. The results of the prerequisite tests for both classes are presented in Table 1 below.

Table 1. Normality and Homogeneity Test

Group	Normality (Sig.)	Homogeneity (Sig.)
Experiment	.051	.138
Control	.059	.138

Source: Processed Data (2023)

Table 1 above shows that the significance value is greater than 0.05, indicating that the generated data is normally distributed and homogenous, allowing for the t-test to be conducted. The data obtained from the t-test is presented in Table 2 as follows.

Table 2. Test t

Group	t	Df	Sig. (2 tailed)	Mean Difference	Std. Error Difference
Experiment	2.960	70	.004	8.611	2.909
Control	2.960	66.175	.004	8.611	2.909

Source: Processed Data (2023)

Based on the data in Table 2, it can be concluded that the significance value of the t-test is less than 0.05, indicating that the IoT-based module is effective in improving students' digital literacy. These results align with the statement of experts who suggest that internet-based modules can enhance the quality of learning and students' digital literacy [5]. Modules contribute to the formation of students' knowledge through self-directed learning [6]. Therefore, the implementation of IoT in modules plays a crucial role for students.

IoT helps students become digitally literate, enhancing their technological skills and digital literacy [13], [23], [31]. The promotion of digital literacy is essential in the era of Industry 4.0, where technological disruptions have brought about new changes, such as human-machine communication and connections through IoT, big data, and virtual education [32], [20].

IoT can be used as a teaching tool in the field of education [25]. Integrating IoT in the learning process facilitates interaction between students and teachers. Moreover, IoT is an ideal platform that should be

taught to students to enhance their digital skills [24]. IoT is referred to as an intelligent system [12], meaning it stores vast amounts of data and information to provide solutions for human life, particularly for teachers and students.

The utilization of IoT services enhances the learning process in schools. Various information can be easily accessed, and it intensifies interaction among students, thereby improving their communication skills [11], [21]. The utilization of IoT brings positive impacts to various stakeholders, including teachers, schools, and students themselves [12]. IoT benefits students by providing important educational information and offering solutions to the problems they encounter [27].

Based on the opinions of several experts mentioned above, schools should provide the necessary infrastructure to support the implementation of IoT, such as computers, internet access, and other devices [33]. The availability of complete technology will effectively enhance digital literacy. If students' digital literacy improves, it will lead to the development of their knowledge, skills, and behavior, all of which are closely linked to technological support [1].

CONCLUSION

The IoT-based module is effective in improving the digital literacy of Class X MPLB students. The obtained t-test result is 0.004. This significance value is less than 0.05, indicating a difference in the level of literacy between the experimental class (X MPLB 1) and the control class (MPLB 2). The experimental class achieved higher scores than the control class after receiving the treatment.

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