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# THE ROLE OF INTERNET OF THINGS TECHNOLOGY IN IMPROVING STUDENTS' DIGITAL LITERACY

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## ABSTRACT
The implementation of digital literacy is very necessary to help students access learning by utilizing modern technology. The Internet of Things is a technology that helps to learn become more effective and efficient with faster connectivity features and the ability to monitor work. The purpose of writing this article is to examine the role of Internet of Things technology in improving students' digital literacy. The research method used is a literature study by examining relevant sources such as books and journal articles that are related to the research topic. The results of the research obtained are that Internet of Things technology plays a role in improving students' digital literacy. The Internet of Things encourages students to interact with the help of the Internet as an information medium. This method can improve connectivity between students, resulting in quality learning. Based on the research results, the conclusion is that Internet of Things technology plays a role in improving digital literacy. The implication is that the improvement of digital literacy using the Internet of Things has an impact on students' mindsets becoming more open to technology, resulting in the formation of advanced human resources. The formation of human resources also affects the quality of education.

Keywords: *Internet of Things, Digital Literacy, Technology*

## 1. INTRODUCTION
The advancement of technology in the era of 4.0 has had a significant impact on the education sector. Technology can be used to support a more modern, effective, and efficient learning pattern in schools. Furthermore, technological developments also encourage students to improve their digital literacy skills. Improved digital literacy will help students understand learning materials more easily (Saripudin, et al., 2021). Students can access, analyze, and evaluate various learning materials using digital technology (Setyaningsih, et al., 2019 & Siddiq, et al., 2016). The ease of access is one manifestation of technological advancements that can contribute directly to the field of education.

The various benefits of technology use should be optimally implemented in the education world. This aims to increase students' digital literacy skills. The use of digital technology can support the literacy skills required in schools (Li et al., 2021). Digital literacy allows students to learn more actively and skillfully (Tejedor et al., 2020). Students can also access learning information by collecting various data easily (Rafi et al., 2019). This information is obtained from various sources so that students can understand, use, access, analyze, evaluate, create, reflect, and take action on the information.

Students are no strangers to technology. Almost all students use technology for daily activities, such as using smartphones. Various digital content can be easily accessed, and all information can be obtained from gadgets (Techataweewan & Prasertsin, 2018). However, not all students have digital literacy. Many cannot use technology to access educational-related matters. Most students use technology for social media or entertainment rather than for learning (Anthonysamy et al., 2020; Ting, 2015). Therefore, teachers must provide direct guidance to make students smart in using technology.

The Internet of Things (IoT) is a technological application that teachers can implement in teaching and learning activities. Technology is a medium that can be used to interact with each other and can provide all types of information (Kumar et al., 2021), often referred to as a smart system (Ahmed, 2021). In line with this statement, IoT is a tool connected to the internet, which functions to collect informative data that can be further processed to understand its meaning (Chaizara & Budiyanto, 2020).

Critical, creative, and innovative thinking are highly needed to develop students' digital literacy (Tinmaz et al., 2022). IoT can be used to improve literacy, especially in the era of 4.0, where analytical thinking and problem-solving skills are essential (Ozkan-Ozen & Kazancoglu, 2021). The implementation of IoT is not only limited to improving digital literacy but in the long run, IoT can shape advanced human resources. This will also impact progress in the education sector. Based on the opinions of several experts above, the purpose of this research is to determine the role of the Internet of Things (IoT) technology in improving digital literacy.

## 2. LITERATURE REVIEW
### 2.1 Internet of Things (IoT)
Technology in the 21st century plays a crucial role in human life. There have been numerous changes since technology began to develop. Most human activities rely on technology (Rafi et al., 2019). Almost everyone, from workers to entrepreneurs and students, uses technology. Students often use technology for learning activities in school. However, many are still unable to utilize technology properly (Anthonysamy et al., 2020).

The Internet of Things (IoT) is a technology that can be used to assist learning activities in schools. IoT can be used for interactive activities to achieve common goals (Eris et al., 2021). IoT provides various information from the Internet that humans need (Kumar et al., 2021). IoT is often referred to as an intelligent system because it can provide different information according to each individual's needs (Ahmed, 2021).

The role of IoT in the field of education is not only limited to transforming conventional learning into modern learning, but it can also bring about changes towards higher-quality education (Gul, et al., 2017). Such changes can support innovative learning, improve the quality of education, and encourage students' e-learning or virtual learning abilities (Kassab et al., 2019). Therefore, teachers should strive to utilize IoT optimally and train students to seek appropriate information relevant to what they are learning.

The habit of using IoT can facilitate students in following lessons. Students' thinking patterns will become more analytical in obtaining information and solving problems (Ozkan-Ozen & Kazancoglu, 2021). Furthermore, in the era of the Fourth Industrial Revolution, critical, creative, and innovative students are highly needed to improve students digital literacy (Tinmaz et al., 2022).

## 2.2 Digital Literacy

Digital literacy is a technological challenge to achieve the competencies and skills needed in life (Blau, Shamir-Inbal & Avdiel, 2020). The rapid development of technology today can encourage people to have digital literacy skills. Someone who has digital literacy is not only able to use technology but must also be able to have efficient and effective multiliteracy skills in processing various sources of information (Anthonysamy et al., 2020).

In the field of education, digital literacy must be implemented properly to avoid the gap between advanced technology and inadequate student skills (Tejedor, et al., 2020). Thinking skills are one of the important components in shaping students' digital literacy (Tinmaz et al., 2020). These skills include critical, creative, innovative, and analytical thinking. All of these aspects play a significant role in improving digital literacy in the 4.0 era (Ozkan-Ozen & Kazancoglu, 2021).

Digital literacy is a multidimensional concept that can be used for long-term education manifestations (Tejedor, et al., 2020). The higher the level of students' digital literacy, the higher the quality of graduates produced (Yustika & Iswati, 2020). The positive effect received in the long run is that the school's achievements will become better and the graduates will find it easier to obtain jobs that match their skills and competencies.

# 3. METHODS

The research method used is a literature review or desk study. According to Sugiyono (2016), a literature review is a research method that examines several academic works through reading, taking notes, and managing relevant research materials. The data sources are collected from various literature such as articles/journals, proceedings, books, and other relevant sources.

# 4. RESULTS & DISCUSSION

Technology and education are inseparable. Advanced education requires modern technology to help teaching and learning activities become more effective and efficient. Likewise, advanced technology is driven by quality education and human resources. One example of technology that can be implemented in the field of education is the Internet of Things (IoT). This technology not only transforms conventional learning into modern ones but can also bring changes to the progress in education (Gul et al., 2017; Kassab et al., 2019).

IoT is referred to as the main driver of smart systems for the future due to its significant benefits for the field of education (Ahmed, 2021), especially in creating quality and sustainable education (Zeeshan et al., 2022). These benefits are inseparable from the IoT services provided, which can ease students' work in understanding learning materials, assist teachers in completing their work, and support schools with digital automation-based systems. IoT services for students can simplify the search for information related to course materials and facilitate interaction with other students (Kumar et al., 2021; Eris et al., 2021).

The implementation of IoT to access learning materials indirectly encourages students' skills in processing information. Students will be trained to think critically, creatively, and innovatively in responding to information (Kassab et al., 2019). This process will have a positive impact on improving students' digital literacy (Ozkan-Ozen & Kazancoglu, 2021). Students can effectively utilize the digital world to obtain important information related to education. In addition, students can find solutions to the problems they encounter (Yustika & Iswati, 2020). Based on the above opinions, the role of IoT in improving students' digital literacy can be explained as follows:

## 4.1 IoT Improves the Quality of Student Learning

The IoT-based learning system facilitates students in following the lessons at school (Kassab et al., 2019). Students are greatly assisted by the IoT system as it can provide various types of information needed (Kumar et al., 2021). IoT also makes it easier for students to complete assignments given by teachers. The use of IoT devices for teaching and learning purposes is a new and innovative approach to education (Tinmaz et al., 2022). According to Gul et al. (2017), some commonly used IoT devices in smart classrooms are Interactive Whiteboards, Tablets and Mobile devices, e-Books, and others. Other IoT devices can be seen in Picture 1 below.


Picture 1. *Smart Classroom*

The picture above illustrates the smart classroom learning technique as part of the IoT system. This technique can be used to determine how students learn. In addition, it helps to make the learning process easier, which can increase students' learning motivation and directly impact the improvement of their digital literacy.

## 4.2 IoT Create Continuous Education

The IoT has the potential to revolutionize conventional education systems (Kassab et al., 2019). Recent studies have identified that the application of IoT can bring about changes towards more quality education for sustainable development. IoT services can be used by schools, teachers, and students (Zeeshan et al., 2022).

The benefits of IoT for students are very helpful in exploring various educational information. IoT also helps students to gain more experience in using modern technologies.

The UNESCO report (2019) emphasizes the importance of technology adoption to promote sustainable education. The adoption should be accompanied by teachers' ability to operate technology (Li & Yu, 2022). Easy access in the modern technology era helps teachers and students to enhance the quality of learning. Teachers can effectively provide innovative technology-based learning to students, while students can easily receive the lessons. Additionally, students can increase their digital literacy skills through regular use of IoT technology in school (Yustika and Iswati, 2020).

## 4.3 IoT Increases Productivity and Learning Interactions

The IoT services for students, such as smartphone-based online classes, virtual classrooms, or e-classes, aim to develop more interactivity among students. Interactive learning can foster students' interest in engaging in different tasks and actively participating in the learning process. Therefore, an IoT-based learning environment can enhance students' productivity and interaction (Zeeshan et al., 2022; Kassab et al., 2019).


Picture 2. The Concept of Digital Literacy (JISC Digital Capacity Framework, 2015)

The implementation of IoT can optimize digital literacy if supported by adequate facilities. Figure 2 shows several components that need to be implemented to achieve digital literacy. One of the components that need to be pursued is the improvement of the quality of learning. Schools need to provide supporting facilities such as computers, laptops, internet, and other devices (Kuputri, 2020). Consistent with this statement, Anthonysamy et al. (2020) stated that the development of effective knowledge, skills, and behaviours in students is supported by digital technology such as mobile phones, tablets, and laptops for collaboration and communication purposes. Digital literacy includes information management, digital skills, and ethical awareness. To effectively utilize technology for learning, one needs to have a certain level of digital literacy.

## 4.4 IoT Encourages the Creation of Innovative Learning

Innovative learning in the era of 4.0 is not just about using certain methods or models to make learning activities more interesting, but it is technology-based learning that can bring a significant impact on education in the future. Technology-based learning provides convenience for both teachers and students (Yustika & Iswati, 2020). For students, technological advancements provide opportunities for online learning, increase self-motivated learning, and ease access to learning materials (Li & Yu, 2022).

Digital technology based on IoT is being promoted in the field of education due to easy access for students (Kassab et al., 2019). One of the advantages of IoT is that it can facilitate distance learning or e-learning, thus increasing the effectiveness of learning (Muharam et al., 2020). The utilization of IoT will encourage students to have digital literacy. The improvement in digital literacy will address the challenges posed by increasingly modern technological advancements (Tinmaz et al., 2022). Students have access to a lot of technology to develop their skills, thus creating competent human resources that meet the criteria of the current job market.

# 5. CONCLUSION

Based on the research and discussion conducted by reviewing several related articles, there are several roles of IoT technology in improving students' digital literacy, as follows: (1) IoT helps improve the quality of students' learning by utilizing smart classroom features, such as Interactive Whiteboards, Tablets, Mobile devices, and e-Books. These features facilitate students in obtaining materials and information and help them to complete their assignments, (2) IoT helps create sustainable education with affordable technology access. The effectiveness of using IoT can improve students' digital literacy so that the goal of sustainable education can be easily achieved, (3) IoT helps increase productivity and learning interaction of students. IoT services such as online classes or e-classes can foster active participation and productivity of students in learning, and lastly (5) IoT encourages the creation of innovative learning. In the era of Industry 4.0, technology-based learning provides opportunities for students to learn online and cultivate self-motivated learning.

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