# THE INFLUENCE OF THE INTERNET OF THINGS IN EDUCATION: META-ANALYSIS

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### *Abstract*

*This research aims to determine the influence of the Internet of Things (IoT) in education. This type of research is meta-analysis research. The research sample came from an analysis of 13 national and international journals. Search research data through google Scholar, ERIC, ScienceDirect, and ProQuest databases. Data search keywords are Internet of Things and Internet of Things in Education. The inclusion criteria in the meta-analysis are publications in 2020-2023, research related to the internet of things in education, publications from indexed journals SINTA, Scopus, and WOS, and research reporting complete data to calculate effect size values. Analysis uses quantitative analysis by calculating the value of effect size with the help of Comperehensive meta-analysis (CMA) applications. The results concluded that the average value of effect size was 0. 95 with high ketogeri effect size. These findings explain the significant influence of the Internet of things in education.*

*Keywords:* Internet of Thing, Effect Size, Education, Meta-analysis

## INTRODUCTION

The development of Internet of things (IoT) technology has changed the way we interact with the world of education (Defranco &; Laplante, 2021). The Internet of Things (IoT) connects various devices and objects around us to the internet (Nesnelerİn et al., 2018), creating a smart and connected ecosystem. In the context of education, IoT can be used to improve the efficiency of teaching and learning, as well as present new opportunities in collecting and analyzing learning data. the influence of the Internet of Things in education is also vast, covering various aspects such as distance learning, the use of smart devices in the classroom, more efficient school management, and more (Kanber et al., 2023; Akbar et al., 2021).

Furthermore, the Internet of Things (IoT) in education has several problems that need attention (Banica et al., 2022). First, is the issue of data security and privacy. With the increasing number of internet-connected devices in educational environments, the risk of breaches of personal data and sensitive information of students and teachers is increasing (Movahed & Bagheri, 2017). Data protection becomes very important so that the information does not fall into the wrong hands or be used incorrectly. Next, second is the

digital divide. Although the Internet of Things (IoT) can bring great benefits in improving learning, there are still many educational institutions around the world that do not have good enough access to the Internet of Things technology infrastructure ( Charytanowicz et al., 2021; Terzieva et al., 2022). This can lead to disparities between schools that have access and those that don't, with a consequent lack of equitable educational opportunities for all students.

While IoT can help improve the learning process, too much reliance on technology can reduce students' interpersonal skills and creative abilities (Abbasy & Quesada, 2020). Therefore, it is important to find the right balance between the utilization of technology and the development of other aspects of education, such as social, emotional, and critical skills. By identifying and addressing these issues, we can maximize the benefits of IoT's influence in education while maintaining important principles such as privacy, equal access, and holistic development of students (Saeed et al., 2021).

The Internet of things can improve students' cognitive abilities in learning (Samsugi et al., 2020). Research (Dai et al., 2021; Hasanah et al., 2018)The application of the Internet of Things  can support the quality of student learning at school. However, research on the same topic actually shows different results so that the conclusions can be subjective. Research Asif Asif et al., (2017) the use of internet of Things in student learning can reduce social interaction. Therefore, there is a need for meta-analysis to draw an accurate and in-depth conclusion. Therefore, this study aims to determine the influence of the Internet of Things (IoT) in education.

**RESEARCH METHOD**

This research is a meta-analysis research. Meta-analysis research is a type of research that collects data from previous primary research that can be analyzed quantitatively (Zulkifli et al., 2022;Chamdani et al., 2022; Nurtamam et al., 2023; Suryono et al., 2023). The research sample came from the analysis of 13 national and international journals. Search research data through google Scholar, ERIC, ScienceDirect, and ProQuest databases. Data search keywords are Internet of Things and Internet of Things in Education. The inclusion criteria in the meta-analysis are publications in 2020-2023, research related to the internet of things in education, publications from indexed journals SINTA, Scopus, and WOS, and research reporting complete data to calculate effect size values. Analysis uses quantitative analysis by calculating the value of effect size with the help of Comperehensive meta-analysis (CMA) applications.

According to Borenstein &; Rothstein (2007), the steps in meta-analysis research consist of 1) formulating problems and determining inclusion criteria; 2) collect and code data from primary research; 3) perform statistical analysis and interpretation of data can be seen in Figure 1. Furthermore, the criteria for the sie effect in this study are guided by the criteria  of Cohen et al., (2007) which can be seen in Table 1.

**Table 1.** Cohen's Effect Size Criteria

| Effect Size | Effect Size Criteria |
|---|---|
| $0.00 \leq ES \leq 0.20$ | Low |
| $0.20 \leq ES \leq 0.80$ | Medium |
| $ES \geq 0.80$ | High |

## RESULT AND DISCUSSION

From searching the google Scholar, ERIC, ScienceDirect, and ProQuest databases regarding the Internet of Things (IoT) in education obtained 214 journals and International. Furthermore, only 13 studies that met the predetermined inclusion criteria were selected. Research data that meet the inclusion criteria are analyzed for effect size values which can be seen in Table 2.

**Table 2.** Value of Effect Size 13 Research

| Study Code | Year | Effect Size | Effect Size Criteria | Journal Index |
|---|---|---|---|---|
| Study 1 | 2020 | 0.66 | Medium | Sinta |
| Study 2 | 2020 | 0.81 | High | Sinta |
| Study 3 | 2021 | 1.32 | High | Scopus |
| Study 4 | 2020 | 2.07 | High | Scopus |
| Study 5 | 2023 | 1.19 | High | WOS |
| Study 6 | 2023 | 0.94 | High | Sinta |
| Study 7 | 2023 | 0.48 | Medium | Sinta |
| Study 8 | 2021 | 0.55 | Medium | Sinta |
| Study 9 | 2022 | 0.79 | Medium | Scopus |
| Study 10 | 2023 | 0.85 | High | Scopus |
| Study 11 | 2021 | 0.82 | Medium | Sinta |
| Study 12 | 2022 | 1.13 | High | Sinta |
| Study 13 | 2023 | 0.74 | Medium | Scopus |
| **Average Effect Size Value** | | **0.95** | **High** | |

Based on Table 3, the effect size values of the 13 studies analyzed ranged from 0.48 to 2.07. Furthermore, the average value of effect size is 0.95 with high criteria. These results conclude that the use of the Internet of Things (IoT) affects the field of education. Research by Aldowah et al. (2017) shows that IoT has brought a positive impact in increasing efficiency in the management of educational institutions. For example, the use of IoT sensors in school building management can help optimize energy use, identify safety issues, and ensure the comfort of the learning environment (Tokarz et al., 2020). With real-time data

generated by the Internet of things (IoT), schools can make better decisions in managing their abilities.

The results of research by Alalade et al., (2019) said that the Internet of Things (IoT) has allowed the learning process to be carried out remotely. With internet-connected devices, students can access course materials, virtual classrooms, and communicate with their teachers from anywhere (Tu et al., 2017; Suharyat et al., 2022). The results show that this has helped improve access to education for those who find it difficult to attend physical school, such as students who live in remote areas or have limited mobility. The influence of the Internet of Things in education has resulted in positive developments in the efficiency of school management and access to distance education. However, there needs to be special attention to privacy and ethical aspects in the use of this technology in education (Fitria &; Simbolon, 2023). The next step is to analyze the influence of the Internet of Things on Indonesian Education. The results of effect size analysis based on education level can be seen in Table 3.

**Table 3.** Effect Size Internet of Things (IoT) based on education level

| Education Level | Effect size | Criterion |
| --- | --- | --- |
| SD | 0.72 | Medium |
| JUNIOR | 0.76 | Medium |
| SMA | 1.06 | High |
| College | 1.17 | High |

Based on Table 3, it explains the effect size at the elementary school education level of 0.72 medium criteria, junior high school of 0.76, high school of 1.06 and college of 1.17. The highest effect size is obtained at the high school and college education level that utilizes the Internet of Things in education. The results are in line with the research of Nurdin et al., (2019) the application of the Internet of Things (IoT) has a positive influence on senior high school students. Next, Schneider research, (2021.) The Internet of things can make it easier for students to complete a task. In addition, universities have adopted the Internet of Things (IoT) to monitor and manage their campus infrastructure more effectively. This includes energy monitoring and management, security surveillance, and better facility maintenance. The results of research in this journal may include specific examples of how IoT technology has helped universities save operational costs, reduce environmental impact, and improve the quality of services on campus.

Furthermore, students who use IoT devices for better data collection and analysis, as well as more interactive and personalized learning experiences (Du et al., 2021). The Internet of Things (IoT) provides a deeper understanding of the potential and challenges of using the Internet of Things in higher education and provides guidance for educational institutions planning to adopt it in learning strategies. (Li, 2022). Therefore, learning that

applies the Internet of Things (IoT) will make it easier for students tounderstand the subject matter

## CONCLUSION

From the results of this meta-analysis, it can be concluded that the average value of effect size is 0.95 with high ketogeri effect size. These findings explain the significant influence of the Internet of things in education. The application of the Internet of Things in education helps learning peoses become more effective and efficient. Internet of Thins (IoT) students can learn online by utilizing technology

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