The Impact of Using the Internet of Things in Improving the Quality of Teachers' Communication and The Quality of Education In Indonesia

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ABSTRACT

The rapid evolution of digital technology in 2026 has positioned the Internet of Things (IoT) as a cornerstone of educational reform globally, particularly in the Indonesian context. This research investigates the strategic impact of IoT integration on two critical dimensions: teacher communication quality and overall education quality. Utilizing a quantitative approach with a sample of 500 educators across various provinces in Indonesia, this study examines how IoT-enabled devices—such as smart whiteboards, wearable technology, and automated attendance systems—facilitate real-time data exchange and interpersonal engagement. The conceptual framework is grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT). Preliminary findings suggest that IoT significantly enhances communication quality by providing teachers with synchronized platforms for student-parent interaction, thereby reducing information asymmetry. Furthermore, the automation of administrative tasks through IoT enables educators to devote more time to pedagogical innovation, which directly correlates with improved educational outcomes. However, the study also identifies persistent challenges, including the digital infrastructure gap between urban and rural regions in Indonesia. This research concludes that while IoT serves as a powerful catalyst for educational excellence, its success depends on equitable access to technology and comprehensive teacher training programs.

Keywords: Internet of Things (IoT), Teacher Communication, Quality of Education, Indonesia, Digital Transformation, UTAUT.

Introduction

As we navigate the year 2026, the global educational landscape is witnessing a profound shift from traditional pedagogical methods to technology-augmented learning environments. In Indonesia, a nation characterized by its vast archipelagic geography and diverse demographic profile, maintaining a standardized, high-quality education system has historically been a significant challenge. The Internet of Things (IoT)—a network of interconnected devices that collect and exchange data—has emerged as a transformative solution to bridge these gaps. According to the Ministry of Education, Culture, Research, and Technology of Indonesia (2024), the integration of smart systems is no longer a luxury but a strategic necessity to fulfil the "Golden Indonesia 2045" vision. The impact of IoT in education extends beyond simple connectivity; it reshapes the fundamental way knowledge is delivered and how stakeholders interact within the academic ecosystem [1], [2].

Communication is the vital artery of the educational process, encompassing interactions among teachers, students, and parents. Traditionally, teacher communication in Indonesia has often been hindered by administrative burdens and a lack of real-time feedback mechanisms. The implementation of IoT addresses these inefficiencies through the use of interconnected platforms that synchronize classroom activities with external communication channels. For example, smart classroom sensors can track student engagement levels and automatically notify teachers and parents of potential learning hurdles. As noted by [3], [4], IoT-driven communication fosters a "proactive" rather than "reactive" environment, where data-driven insights allow teachers to communicate more precisely and empathetically.

Furthermore, the quality of teacher communication is significantly enhanced by reducing manual data entry. Wearable devices and smart attendance systems automatically update student records, allowing teachers to focus their communicative energy on mentoring and complex problem-solving. This shift is critical in the Indonesian context, where large class sizes often dilute the quality of individual teacher-student interactions. By automating the "low-value" tasks, IoT enables a more high-touch, personalized communication style that is essential for modern learning [5].

The broader quality of education in Indonesia is directly influenced by the availability of resources and the efficiency of school management. IoT contributes to educational quality by creating "Smart Schools"—environments where every physical asset, from lighting systems to laboratory equipment, is optimized for learning. In rural areas of Indonesia, IoT-enabled remote learning stations have begun to provide students with access to high-quality instructional materials that were previously restricted to urban centers. This democratization of information is a key indicator of improving national educational standards (OECD, 2023).

Predictive analytics, a subset of IoT functionality, allows educational institutions to monitor student performance trends over time. By analyzing data collected from various touchpoints, schools can intervene early when a student is at risk of falling behind. This precision in educational delivery ensures that the "Quality of Education" is not just a theoretical goal but a measurable outcome. According to research by [6], [7], the transparency provided by IoT systems increases institutional accountability, a prerequisite for significant improvement in national education rankings such as the PISA (Program for International Student Assessment).

To analyse the adoption and impact of IoT in Indonesian schools, this study utilises the Unified Theory of Acceptance and Use of Technology (UTAUT). The model posits that four key constructs, performance expectancy, effort expectancy, social influence, and facilitating conditions, determine the intent to use technology. In the context of Indonesian teachers, performance expectancy (the belief that IoT will improve their job performance) is a major driver of communication quality. However, facilitating conditions, such as the quality of internet infrastructure in remote islands like Papua or East Nusa Tenggara, remain a significant hurdle. Venkatesh et al. (2003), the originators of the UTAUT model, emphasise that technology alone cannot improve outcomes unless the users perceive it as both useful and accessible.

Despite the optimistic potential of IoT, Indonesia faces a unique set of challenges related to the "digital divide." While Jakarta and other major cities on Java enjoy high-speed 5G connectivity and advanced IoT deployments, the peripheral regions often struggle with basic internet access. This disparity creates a risk where IoT could inadvertently widen the educational inequality gap rather than close it. Recent reports suggest that 30% of schools in remote Indonesian regions still lack consistent electricity and stable network infrastructure (World Bank, 2025). Therefore, evaluating the impact of IoT must be done with a critical eye on equity and infrastructure development.

Moreover, the human element- specifically, teacher readiness is a crucial factor. The introduction of IoT devices requires a paradigm shift in teacher training. Many educators, particularly those from older generations, may experience "technostress," which can temporarily degrade the quality of their communication. As highlighted by [8], [9], [10], the psychological impact of constant connectivity can lead to burnout if not managed through appropriate organizational support and work-life balance policies.

While international literature on IoT in education is abundant, there is a lack of localized research that specifically focuses on the *synergy* between IoT, teacher communication quality, and national educational standards within Indonesia. Most existing studies focus on the technical implementation of sensors or the cost-benefit analysis of smart devices. There is an urgent need to explore the "human-centric" impact: how do these interconnected devices change the way a teacher in a remote Indonesian

village speaks to a student or reports to a parent? This research addresses this gap by providing empirical evidence from the Indonesian frontline.

Research Methods

This study uses a qualitative, descriptive case study approach to explore in depth how the implementation of the Internet of Things (IoT) affects the quality of teacher communication and education in Indonesia. The choice of qualitative methods is driven by the need to understand complex phenomena in real-world contexts that cannot be adequately explained by numbers alone [11], [12], [13]. Research participants were selected using a *purposive sampling* technique, comprising teachers, principals, and IT experts from schools that have integrated smart classroom technology in both urban and rural areas. Data collection was carried out through three main techniques: semi-structured *in-depth* interviews to explore individual perceptions, participant observation of teacher-student interactions in IoT-based classrooms, and documentary studies of digital recordings and academic performance reports [14], [15], [16].

To ensure data validity, this study employed technical and source triangulation, and conducted *member checking* with participants to verify the accuracy of the findings [17]. Data analysis was conducted inductively using an interactive analysis model, comprising the stages of data condensation, data display, and conclusion drawing/verification. The entire research process was conducted with high regard for research ethics, including providing *informed consent* and guaranteeing participant anonymity to obtain honest perspectives on infrastructure and psychological barriers to technology adoption in Indonesian educational environments.

Result And Discussion

Based on a thematic analysis of in-depth interviews, classroom observations, and documentation from various educational institutions in Indonesia, four central themes emerged that describe the transformation of *Internet of Things* (IoT)-based education.

Transformation of Communication Patterns: From Reactive to Proactive

The main findings of this study indicate that integrating IoT devices, such as Smart Dashboards and Wearable Devices, has changed the structure of teacher communication. Previously, communication between teachers and parents was reactive—only occurring when academic or behavioral issues arose. However, with IoT sensors monitoring student attendance and participation in *real time*, communication has become more proactive: *"I used to have to manually record attendance every week before reporting. Now, the IoT system sends automatic notifications to parents' phones if a student is absent from class within the first 15 minutes. This reduces my administrative burden and makes parents feel more instantly involved."* (Informant 1, High School Teacher in Jakarta).

Observational data show that the quality of teacher-student interactions in the classroom has also improved. *Connected Whiteboards* devices allow teachers to share notes directly to students' devices, freeing up time typically spent copying materials for in-depth discussions and personalized feedback. Communication is no longer one-way; IoT creates an ecosystem in which data serves as an objective intermediary between teachers, students, and parents [18].

Improving the Quality of Education Through Personalized Learning

IoT enables "adaptive learning," a key indicator of the quality of modern education. Through IoT-integrated *Learning Management Systems* (LMS), teachers can monitor how long a student engages with a particular topic. This data provides psychological insights into a student's level of comprehension that are not readily apparent in conventional exams.

Document analysis shows a 15% increase in average grades in schools that have implemented IoT over the past two semesters. This is not because technology replaces teachers, but rather because it provides teachers with "digital eyes" to identify students who are falling behind early. In remote areas, the use of IoT in virtual laboratories enables students to access sophisticated scientific experiments without the need

for expensive physical equipment, thereby directly improving educational standards in disadvantaged areas (OECD, 2023).

Infrastructure Challenges and the "Digital Divide" Paradox

In-depth discussions revealed a glaring gap in IoT effectiveness. In urban schools with 5G connections, IoT runs smoothly. However, in rural areas like East Nusa Tenggara or Papua, IoT often becomes a burden due to its dependence on stable electricity and signal stability: *"We have the equipment, sent from the center. But it often just serves as a display because the internet signal in our village is intermittent. Instead of helping, this system failure actually hinders our teaching process."* (Informant 4, junior high school teacher in the 3T region).

This phenomenon creates what has been called "false digital maturity." National education quality cannot be said to be improving if IoT only widens the gap between elite and marginal schools. As stated by the World Bank (2025), basic infrastructure is an absolute prerequisite before the pedagogical benefits of IoT can be felt evenly across the archipelago.

Psychological Burden and Technostress on Educators

One of the most crucial findings from this discussion was the rise of *technostress* among senior teachers. While IoT improves efficiency, 24/7 connectivity creates the expectation that teachers must always be available to respond to data or questions from systems and parents. Mental workload increases as teachers must manage two realities simultaneously: physical interactions in the classroom and data management on the IoT *dashboard*. If not adequately trained, IoT use can actually degrade communication quality because teachers feel cognitively overwhelmed. This aligns with the theory of Tarafdar et al. (2019), which states that without strong organizational support, technology can backfire on educators' productivity and mental well-being.

IoT integration in education in Indonesia is not merely about hardware procurement; it is a paradigm shift in knowledge management. This study confirms that teacher communication improves when technology acts as *an enabler*, not *a* substitute. The success of IoT in Indonesia depends heavily on "Human Readiness. "

Theoretically, these qualitative findings extend the UTAUT framework by adding the "Geographic Context" variable as a key determinant in an archipelagic country like Indonesia. The discussion concludes that to achieve superior educational quality, the government must shift from a "one-size-fits-all" policy to one based on local needs. Schools in remote areas require IoT that can operate offline (or with limited bandwidth), while schools in urban areas require regulations on data ethics and work-life balance to prevent teacher *burnout*. In conclusion, IoT is a double-edged sword. On the one hand, it offers unprecedented data precision and communication efficiency. On the other hand, it demands massive infrastructure responsibilities and psychological support. The quality of Indonesian education will only truly improve if IoT is used to rehumanize the teacher-student relationship rather than simply turning classrooms into data-processing plants (Al-Emran et al., 2020).

Conclusion

This qualitative study concludes that the implementation of *the Internet of Things* (IoT) has had a significant yet complex, transformative impact on the quality of teacher communication and education in Indonesia. More in-depth, these findings can be summarized in the following key points. Increased Communication Efficiency: IoT has successfully shifted teachers' communication paradigm from reactive to proactive. *Real-time* data integration via smart devices enables teachers to provide more precise, rapid feedback to students and parents, thereby enhancing transparency in the learning process. Accelerating Quality through Personalization: The use of IoT facilitates the creation of adaptive learning environments. With the ability to digitally monitor individual progress, the quality of education improves because pedagogical interventions can be more personalized and data-driven (data-*driven instruction*). Infrastructure Constraints as a Key Barrier: There is a significant gap in IoT success between urban and rural areas in Indonesia. Limited electricity and internet infrastructure in remote areas (3T) creates the risk of "digital inequality," where the benefits of IoT are not shared equally, potentially widening the gap in national education quality. Human Readiness Factor: The success of this technology depends not only on

the hardware but also on the psychological readiness of educators. The rise *of technostress* among teachers underscores the need to balance technological automation with support for educators' mental well-being.

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