

Empowering Internet of Educational Things (IoET) to Develop Digital Capabilities for Wahid Hasyim Junior High School Teachers

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Abstrak Pandemi COVID-19 telah menyebabkan pergeseran pembelajaran berbasis digital, menciptakan kesenjangan pembelajaran yang signifikan di era Kurikulum Merdeka ketika pendidikan tatap muka dilanjutkan. SMP Wahid Hasyim Malang, seperti halnya sekolah-sekolah lain, menghadapi tantangan seperti interaksi guru-siswa yang terbatas, ketergantungan pada ceramah tradisional, sumber daya yang sudah ketinggalan zaman, dan fasilitas internet yang kurang dimanfaatkan. Untuk mengatasi hal ini, kami mengusulkan program pemberdayaan Internet of Educational Things (IoET). Tujuannya adalah untuk membangun lingkungan belajar berbasis digital pasca pandemi menggunakan modul berbasis *hypercontent* dan *Learning Management System* (LMS) dengan aplikasi IoET. Instruktur akan memberikan pelatihan dasar, dan fasilitator akan memberikan pendampingan yang berkelanjutan. Program ini membekali para guru dengan pengetahuan teoretis dan keterampilan praktis, meningkatkan kemampuan mereka untuk menerapkan model dan media pembelajaran berbasis IoET, sehingga dapat meningkatkan kinerja mereka secara keseluruhan. Selain itu, program ini akan berfungsi sebagai referensi berharga untuk layanan pendidikan dan penelitian di masa depan, menjadi titik acuan alternatif untuk berbagai upaya pendidikan dan inisiatif penelitian di masa depan.

Abstract The COVID-19 pandemic has led to a digital-based learning shift, creating a significant learning gap in the Merdeka Curriculum era as face-to-face education resumes. SMP Wahid Hasyim Malang, like many others, faces challenges such as limited teacher-student interaction, reliance on traditional lectures, outdated resources, and underutilized internet facilities. To address this, we propose an Internet of Educational Things (IoET) empowerment program. Its goal is to establish a digital-based learning environment post-pandemic using hypercontent-based modules and Learning Management Systems (LMS) with IoET applications. Instructors will provide foundational training, and facilitators will offer ongoing mentoring. This program equips teachers with theoretical knowledge and practical skills, enhancing their ability to implement IoET-based learning models and media, improving their overall performance. Additionally, it will serve as a valuable reference for future educational services and research,

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becoming an alternative point of reference for various future educational endeavors and research initiatives.

Thaariq *et al*

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95

INTRODUCTION

The gradual digitalization of the education system has been facilitated by the development of information and communication technology (ICT). The COVID-19 pandemic has accelerated this process, making it a crucial aspect of education in the future. As a result, educators and students must adjust to the new ICT-based education system. However, the transition to a digitised system is not yet fully realized, and government agencies and educational institutions must develop sustainable long-term strategies to ensure its success (Bakator & Radosav, 2020). As delineated in point 4 of the 2030 Sustainable Development Goals (SDGs), the imperative is to guarantee inclusive and equitable quality education, and foster lifelong learning opportunities for all. This has engendered a pressing need for a society that is proficient in technology and capable of confronting the multifarious challenges of the contemporary digital era. Consequently, most developing countries, including Indonesia, have evinced a strong desire to furnish schools with high-quality digital learning materials and facilities, human resources, and requisite components to cultivate a technologically adept workforce (Kalolo, 2019).

Contemporary educators are compelled to adopt a forward-thinking approach in order to ascertain the necessary measures to remain pertinent and effectively cater to the needs of society in the forthcoming era. The educational framework must equip learners with the requisite skills to navigate a landscape wherein novel technologies, an overwhelming influx of information, and the advent of the Fourth Industrial Revolution have rendered the existence of future occupations uncertain (Ally, 2019). The global demand for lifelong learning is experiencing a substantial increase due to the recognition that individuals require current and pertinent education to lead a purposeful existence (Kolenick, 2018; Patterson, 2018). Consequently, this situation has compelled educators to pay close attention to fostering the development of digital skills that are essential for the acquisition of knowledge (Lund et al., 2014).

The present facilitation extends to Wahid Hasyim Junior High School, a service partner situated at Jl. MT Haryono Gg. 10 No. 165 Malang. In response to the COVID-19 pandemic, the teachers at this institution have implemented digital-based learning (Kuswandi, Thaariq, Kurniawan, et al., 2021). Furthermore, they have acquired knowledge and skills pertaining to digital learning media through prior programs (Thaariq, Ramadhani, et al., 2020).

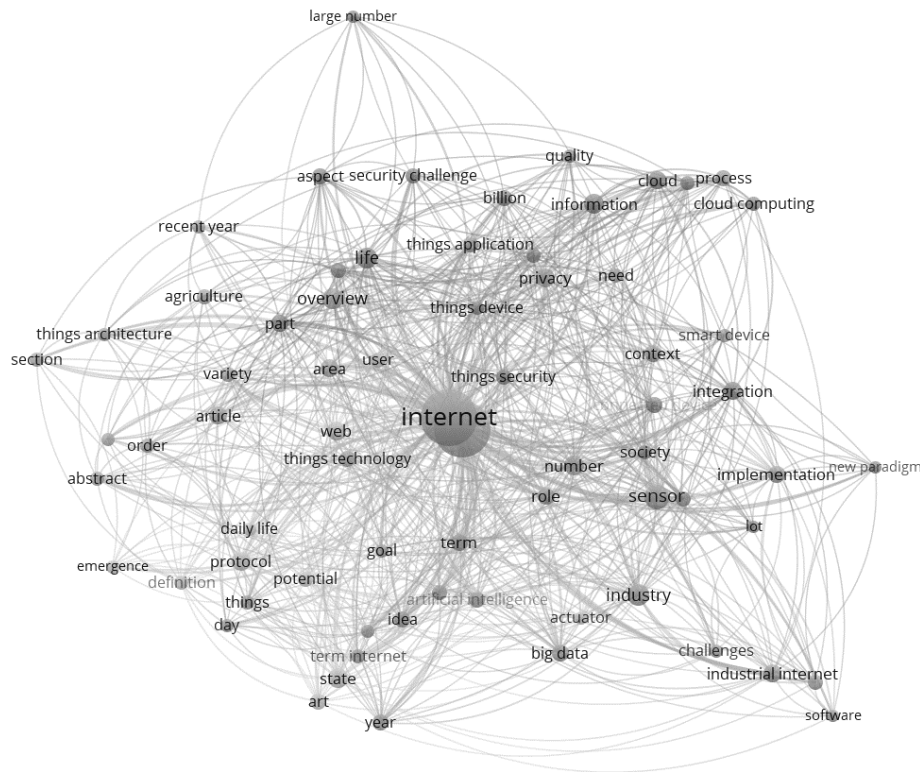
In response to the decline in the number of coronavirus victims in Indonesia, face-to-face learning has been reintroduced. However, this has resulted in symptoms of learning loss among students. To address this issue, the Kemdikbudristek has implemented various simplifications through the Merdeka Curriculum since the end of February 2022 (Kemdikbudristek, 2023). One of the schools that has adopted this curriculum is the Wahid Hasyim Junior High School. While the school has been able to adapt to the changes brought about by the curriculum, further empowerment is necessary to ensure optimal learning outcomes. This is evident from several gaps that have been identified, including limited interaction between teachers and students, continued reliance on lectures as a teaching method, conventional learning resources, and underutilization of internet facilities for educational purposes.

The teacher's proficiency in managing and utilizing the internet as an educational resource falls under the technological knowledge competence category within the Technological Pedagogical Content Knowledge (TPACK) framework (Koehler & Mishra, 2009). The

utilization of the internet for educational purposes, employing various forms, methods, and techniques, is referred to as the "Internet of Educational Things." This term is derived from the concept of the Internet of Things (IoT) and is specifically applied to the field of education (Pruet et al., 2015). The IoT paradigm can be defined as the notion that numerous objects in our surroundings will be connected to a network in some capacity (Y. Wang, 2010). In simpler terms, objects or things in the immediate environment, such as televisions, lights, cars, mobile phones, and even plants, are equipped with smart sensors that enable communication and interaction through wireless networks or the internet, regardless of location or time. The integration of mobile devices and sensors into smart objects introduces the concept of the Internet of Things, which will usher in a new era in the educational setting (Pruet et al., 2015).

Previous research has been conducted on the utilization of the Internet of Things (IoT) in the field of education. Xu (2022) found that the use of IoT for evaluation purposes can significantly enhance teaching quality by more than 90%. Furthermore, the evaluation process is considerably shorter compared to traditional methods, and it positively impacts the assessment of learning quality. Additionally, students' satisfaction with the quality of learning has increased by 5.8%, and their professional abilities have shown improvement ranging from 6 to 25 points. Another study by Shang (2022) focused on the application of IoT in English language materials. The findings revealed significant advancements in grammar, length, expression, and structure, thereby optimizing students' pre-class preview, autonomous learning motivation, homework completion quality, and post-class reflection behavior. Moreover, Wang (2022) conducted research on simulation-based IoT, which demonstrated its ability to enhance understanding, mastery, and application of practical techniques. The results indicated that this platform facilitates intuitive teaching content and real-time collection of teaching activity data. The interaction between students greatly assists teachers in strengthening their guidance throughout the learning process, ultimately improving the overall quality of education.

The selection of the Internet of Things (IoT) as a means of empowerment for teachers at Wahid Hasyim Junior High School was motivated by the recognition of its potential benefits. The novelty and significance of this topic are evident in the following discussion.



According to the depicted Figure 1, the predominant focus of research and service in the realm of Internet of Things (IoT) remains concentrated within broad domains, including security and agriculture, among others. However, the application of IoT in the field of education has not yet gained significant momentum. Consequently, the development and utilization of IoT for educational purposes by researchers and other stakeholders is relatively uncommon in comparison to prevailing trends in research and service. Therefore, the selection of this particular topic by the implementer is motivated by its inherent novelty and potential for exploration.

The execution of this community service initiative engaged a total of 21 educators from Wahid Hasyim Junior High School. The approach employed for implementing the Internet of Educational Things (IoET) empowerment for the teachers at Wahid Hasyim Junior High School was derived from the ADDIE process, encompassing the stages of analysis, design, development, implementation, and evaluation (Branch, 2010). However, certain adjustments were made to the process to cater to the specific requirements of the service partners. The implementation of this endeavor was meticulously planned and executed in a series of sequential stages.

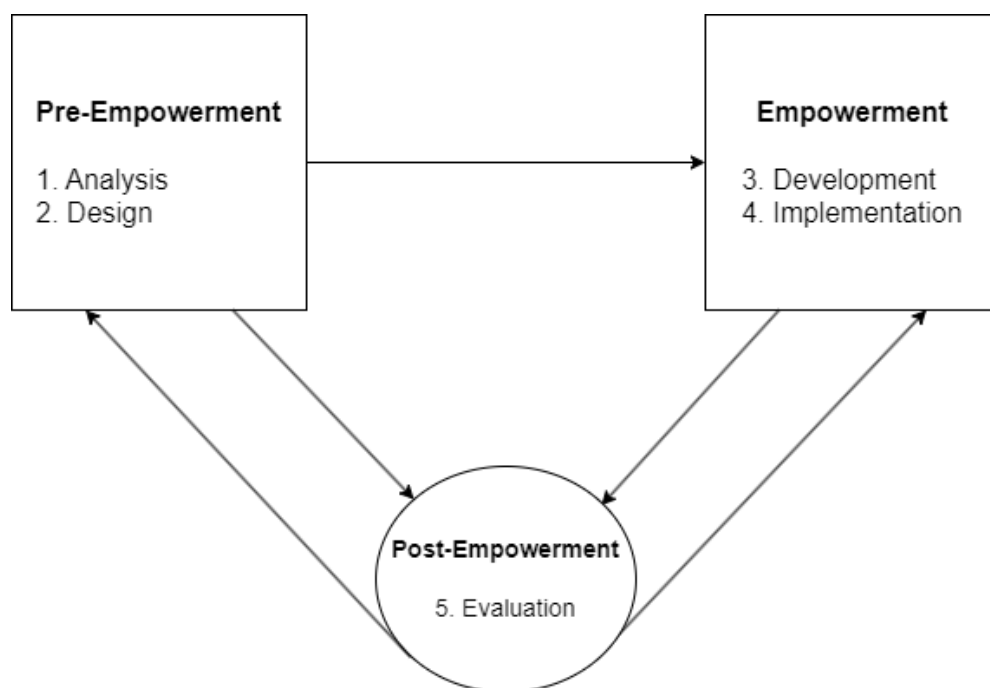


Figure 2 Empowerment model implemented

The initial phase of the process involves analysis, which aims to identify the potential causes of the learning performance gap. To discern the gap, the implementer conducts an interview with the Deputy Head of Curriculum, ascertains the learning objectives by taking into account the curriculum utilized at Wahid Hasyim Junior High School, identifies the learning resources employed by both teachers and students, analyzes the characteristics of the teachers and students, and identifies the system and facilities available at the school. This analysis is conducted by comparing the actual performance with the desired performance as a reference to determine the root cause of the problem. The participants of the activity establish the learning objectives based on the learners' abilities, capabilities, experiences, and availability.

The subsequent phase entails the design aspect. During this stage, the individual responsible for implementation formulates strategies and blueprints to achieve the desired performance outcomes, while adhering to the prescribed testing methodology. This process involves compiling educational materials for the participants, assigning specific tasks to each member of the implementation team, developing a comprehensive work plan within the designated timeframe, and creating performance assessment tools for the participants' engagement in the activities.

The third phase of the instructional design process is the development stage. This particular stage involves the creation and validation of the learning resources required for the learning module. Various activities are undertaken during this stage, such as generating content specifically tailored for the teachers at Wahid Hasyim Junior High School, selecting appropriate media to support the empowerment program, developing instructional materials for teaching purposes, creating synchronous and asynchronous instructions for participants engaged in the activities, and producing formative tests to evaluate the effectiveness of the training outcomes.

The fourth stage of the process is the implementation phase, which focuses on preparing the learning environment and involving teachers in the training. The training process itself

encompasses several key components. Firstly, there is the delivery of educational material on the Internet of Educational Things, followed by a question and answer session to ensure understanding. Secondly, there is a workshop discussion centered around the design and needs of the learning environment. Thirdly, there is a demonstration of internet-based media making techniques, showcasing the various stages involved. Furthermore, teachers are assigned tasks to create learning media asynchronously through a learning management system (LMS). These assignments are then discussed and evaluated in each training session, allowing for feedback and improvement. Finally, an overall evaluation discussion takes place to gather feedback on the empowerment process and the resulting services. This comprehensive approach ensures that the implementation phase is thorough and effective in achieving its objectives.

The fifth stage in the process is evaluation, which involves assessing the quality of each stage and procedure that has been conducted. The evaluation is based on aspects that are aligned with the objectives of the service activities at Wahid Hasyim Junior High School. Formative evaluation is conducted by comparing the results of pre-tests and post-tests, as well as exploring participants' perceptions of the empowerment activities that have been implemented. This comparison is in line with the evaluation stages outlined by [Spector & Yuen \(2016\)](#), which include pre-assessment, assessment, and post-assessment. The sustainability of this activity aims to enable teachers in partner schools to address learning difficulties by utilizing Internet of Educational Things (IoET) in accordance with the evolving learning paradigm. Furthermore, the sustainability of this training program is expected to enhance teacher performance in teaching at Wahid Hasyim Junior High School. The implementation of the empowerment program by the facilitator is anticipated to be widely disseminated, serving as an exemplary model for empowering junior high school teachers in utilizing internet-based learning technologies.

RESULTS AND DISCUSSION

Educational technology is a widely accepted scientific concept that endeavors to address educational challenges by implementing performance enhancement measures that facilitate comprehensive learning ([Januszewski & Molenda, 2013](#)). Internet of Things (IoT) has been increasingly used in the educational technology context. IoT technology has been used in various educational settings, including distance education courses, tertiary institutions, and smart transportation systems. The benefits of IoT in education include improving learning outcomes, enhancing educational management, and increasing interest in technopreneurship. However, there are also challenges to utilizing IoT in education, such as the digital divide, financial constraints, and network and data security. The use of IoT in education has been found to be high among university students ([Yessengabylov et al., 2022](#)). IoT integration in education will transform Education 4.0 and improve learning outcomes significantly ([Dake et al., 2023](#)).

[Rose et al. \(2015\)](#) identified four communication models in the context of the Internet of Things (IoT), namely the Device-to-Device model, the Device-to-Cloud model, the Device-to-Gateway model, and the Back-End Data-Sharing model. The Device-to-Device model involves direct communication between two or more IoT devices, without the need for an intermediary application server. Bluetooth is an example of a technology that facilitates this model. The Device-to-Cloud model, on the other hand, involves IoT devices connecting directly to Internet services, such as application service providers, to exchange data and control message traffic. Chat applications are an example of this model. The Device-to-Gateway

model involves IoT devices connecting to cloud services through application layer gateway services, which serve as a channel for communication. Finally, the Back-End Data-Sharing model is a communication architecture that enables users to export and analyze smart object data from cloud services in combination with data from other sources (Thaariq, 2022).

The Internet of Educational Things (IoET) refers to the integration of technology and connectivity in educational settings, revolutionizing traditional learning environments. IoET encompasses the use of smart devices, such as interactive whiteboards, tablets, and wearable devices, to enhance the learning experience. These connected devices enable educators to create personalized and interactive lessons, track student progress and provide real-time feedback, and offer access to unlimited educational resources and online libraries. With IoET, learning becomes collaborative, accessible, and tailored to individual needs, empowering students to become active participants in their education. The integration of technology in education through IoET promises to revolutionize the traditional classroom, fostering a more engaging and effective learning experience for students of all ages.

Drawing from the aforementioned elucidation, the present service centers on the Device-to-Cloud paradigm in the Internet of Educational Things (IoET), as explicated by the Deputy Head of Curriculum at Wahid Hasyim Junior High School. This approach entails that the program empowers the participants, who are the teachers at Wahid Hasyim Junior High School, to effectively leverage the internet on their devices for the purpose of enhancing the learning activities. To this end, a framework has been devised, which is illustrated in Figure 3.

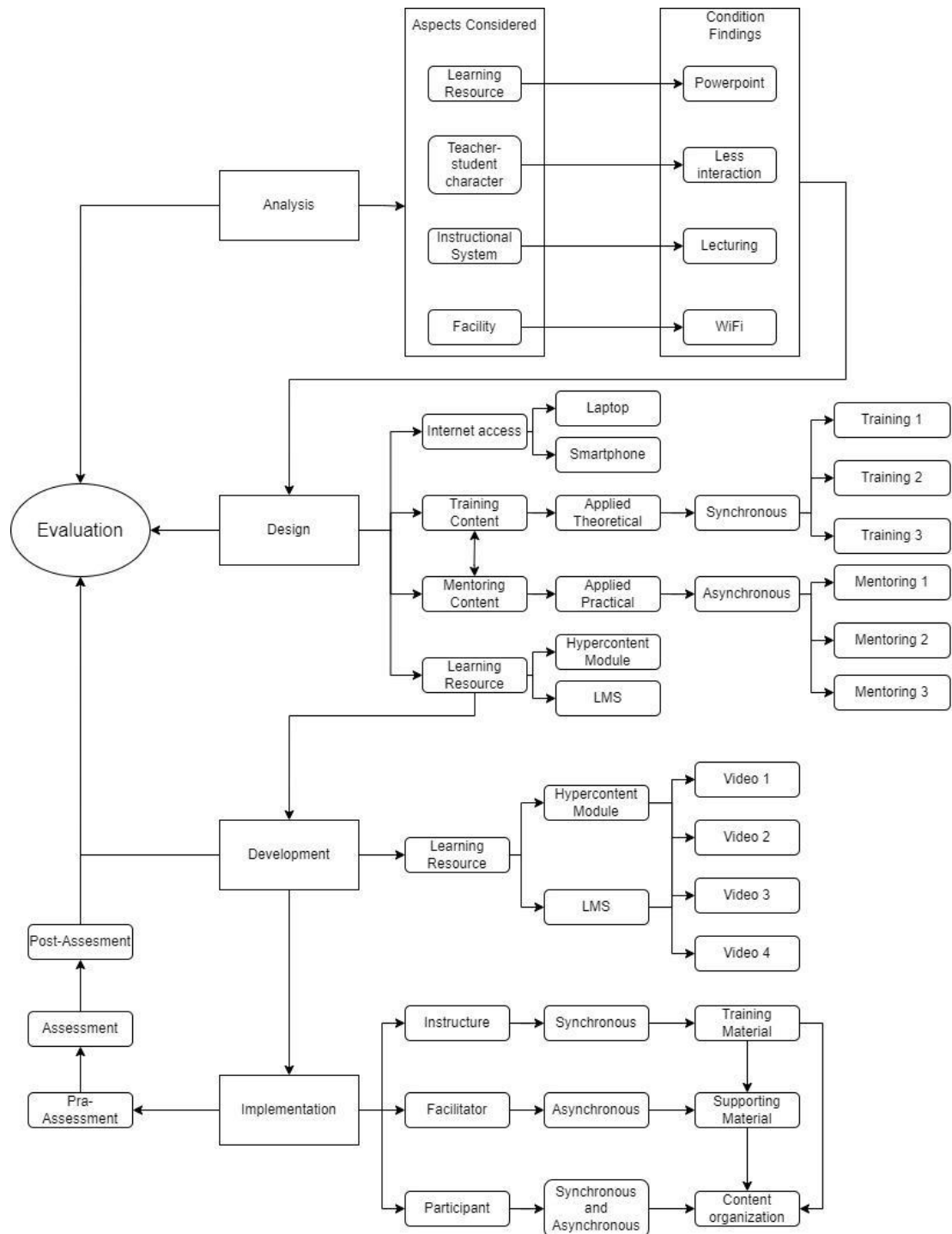


Figure 3 IoET Empowerment Scheme adapted from ADDIE Model

As expounded in the introduction, there exist noteworthy findings that merit attention. Firstly, with regards to the dearth of interaction between educators and learners, it is widely acknowledged that the COVID-19 pandemic has had a profound impact on numerous critical sectors, including education. The implementation of the “Belajar dari Rumah (BDR)” policy has resulted in the proliferation of online learning, thereby necessitating that students experience this phenomenon as a learning subject. Upon returning to face-to-face learning at partner venues, students have been observed to exhibit a decline in physical social contact. This assertion is predicated on the experiences of educators who have noted that students tend to remain reticent or even refrain from interacting with their peers or instructors during

learning sessions. This state of affairs is problematic, given that students require communication and collaboration skills in line with the 21st-century paradigm (Kuswandi, Thaariq, & Wijanarko, 2021). Furthermore, classroom participation has been shown to have social benefits for student development (Laal & Ghodsi, 2012) including (1) contributing to the development of a social support system for students, (2) fostering the cultivation of diverse perspectives among students and educators, and (3) creating a positive atmosphere for collaboration.

In relation to the utilization of lectures as a means of learning, it is evident that despite the implementation of various media by educators, the learning methods remain predominantly traditional. For instance, when incorporating podcasts, students are frequently instructed to attentively listen and subsequently complete assigned tasks, such as summarization. This suggests that while diverse learning media have been employed, the execution of the learning process remains conventional. To effectively employ learning patterns and harness their potential, it is imperative that teachers possess confidence and provide support (Thaariq, Lindawati, et al., 2020; Thaariq, Surahman, et al., 2020).

Thirdly, in relation to the persisting utilization of traditional learning resources, numerous educators continue to rely on conventional media such as modules, books, and physical Learner Worksheets (LKPD) as the primary instructional materials for their students. The contemporary student population, often referred to as digital natives, necessitates access to current resources in order to enhance their educational journey (Akintunde, 2013). Kozma (2003) asserts that the integration of technology by educators in lesson planning, collaboration with external entities, as well as the utilization of technology by students in research endeavors, data analysis, problem-solving, product design, and self-assessment, facilitates the development of digital competencies encompassing problem-solving, information management, collaboration, and novel communication proficiencies. Consequently, learning materials that optimize students' educational experiences are imperative for the comprehensive enhancement of their skill sets. Nevertheless, a positive aspect noted during the interview observations conducted by the implementers was that teachers in the collaborating institutions made efforts to comprehend the distinct characteristics of their diverse student body. This indicates that teachers frequently adjust their teaching approaches to accommodate the needs of their students, as evidenced by the varying employment of instructional methods in each classroom.

The necessity of implementing this community service arises from the inadequate provision of optimal WiFi facilities for educational purposes. This can be observed through the partner's observations, which indicate that students heavily rely on the internet as a primary source of information. Conversely, teachers in the partner institutions tend to view the internet merely as a tool for learning. For instance, the internet is predominantly used for cognitive assessments, while the learning process itself relies more on physical books or modules, which are then presented using LCD projectors. Furthermore, internet usage is restricted to specific time frames. From the perspective of learning patterns (Abidin, 2016), this approach falls under the category of teacher-centered learning. However, in the 21st century, student-centered learning is crucial, as it emphasizes the mastery of student experiences. Students must develop digital competencies to effectively navigate the challenges of modernization and be empowered to face its dynamic developments.

Upon reviewing the qualitative findings, we embarked on the development of an empowerment program that is centered on internet media as a learning resource. This program

is intended to be accessible to all participating teachers through the use of laptops or smartphones. Subsequently, we formulated an Internet of Educational Things (IoET) empowerment strategy, which comprises two distinct approaches: training and mentoring. The training program is designed to be delivered synchronously with theoretical materials, while the mentoring component is intended to be implemented asynchronously. The resources that will be utilized in this program include hypercontent-based modules and Learning Management Systems (LMS). Once the programme had been designed, our team embarked on the development of the necessary resources for training and mentoring purposes, specifically the hypercontent-based module and Learning Management System (LMS). The modules we created were designed to be multimedia-oriented, encompassing a wide range of content, primarily consisting of videos. This approach was also adopted in the development of the LMS. Consequently, we dedicated efforts to producing learning videos that would serve as a valuable supplement to the module and LMS, playing a pivotal role in enhancing participants' learning experience. We acknowledge the significant appeal and efficacy of visual learning, as it facilitates participants' comprehension and absorption of the material. Hence, our focus was on generating high-quality videos that offer clear instructions and pertinent material, aligning with our educational objectives. By integrating hypercontent-based modules, LMS, and interactive learning videos, our ultimate aim is to establish an innovative and efficacious learning environment for our participants.

Upon completion of the development and design of the IoET programme, preparations were made to deliver it to teachers at Wahid Hasyim Junior High School. The training process involved the preparation of instructors, facilitators, and participants. Instructors were tasked with presenting the material, possessing a comprehensive understanding of the content and the ability to convey it effectively. Their primary responsibility was to ensure that teachers had a thorough comprehension of the concepts and applications of the IoET programme. Facilitators played a crucial role in supporting instructors in delivering the material, acting as intermediaries between instructors and participants. They provided additional assistance, answered questions, facilitated discussions, and offered practical examples and relevant case studies to aid teachers in implementing the IoET programme in their teaching. Participants, in this case, the teachers of Wahid Hasyim Junior High School, were the recipients of the theoretical materials presented during the training. They were responsible for actively engaging in the training, seeking clarification when necessary, and participating in discussions to enhance their understanding.

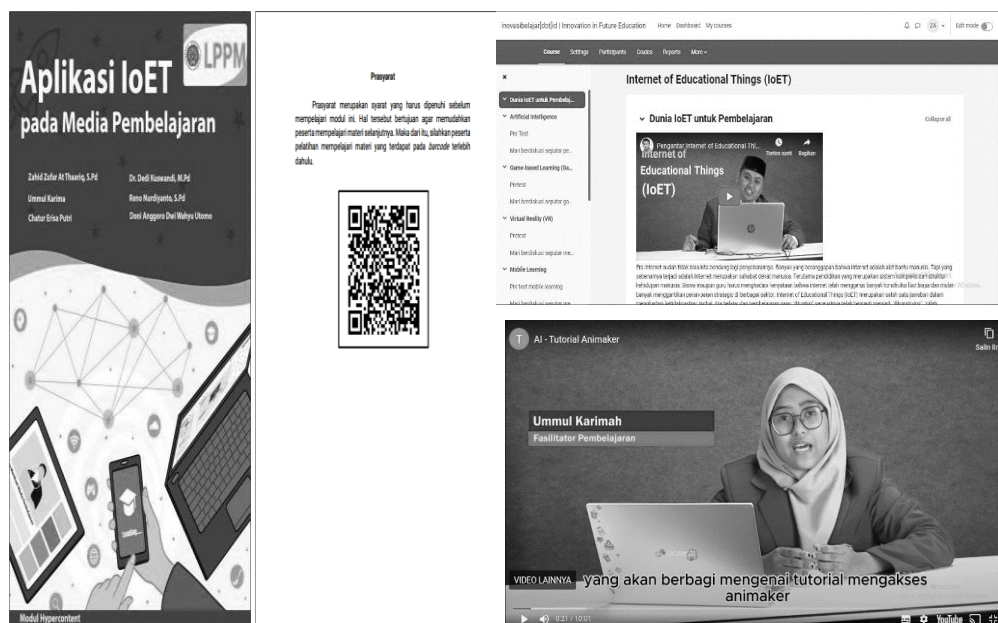


Figure 4 SEQ Figure * ARABIC 4 Modules, LMS and Videos developed

Following the theoretical training, the mentoring process commenced, which involved facilitators acting as mentors and teachers as mentoring participants. The facilitators assisted the teachers in applying the concepts learned in their daily teaching, ensuring that they could integrate the IoET programme effectively into their curriculum and provide maximum benefits to their students. This stage was critical in ensuring the successful implementation of the IoET programme.



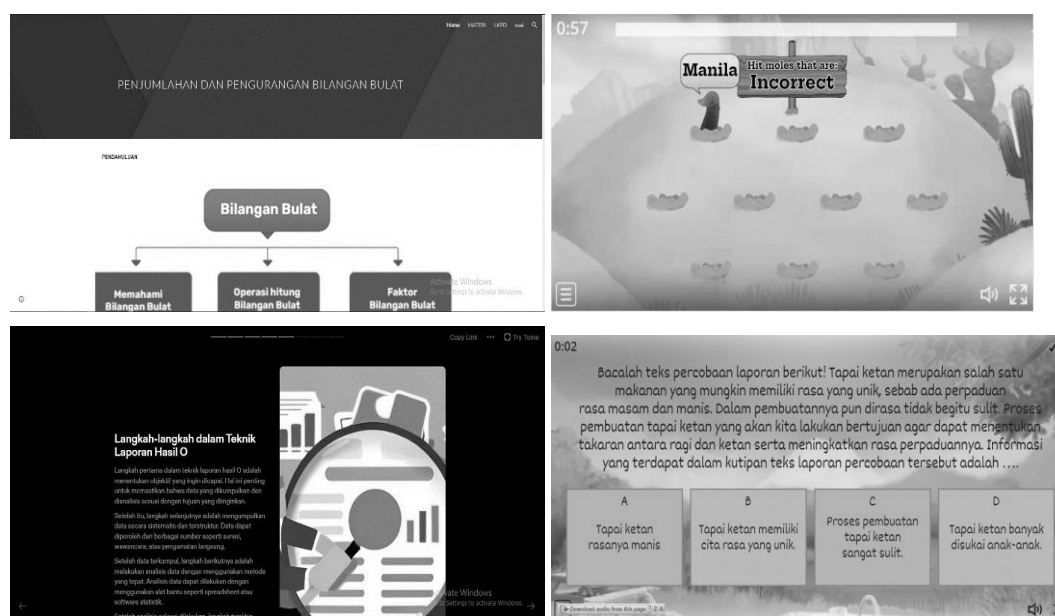
Figure 5

Following the implementation of the programme, an evaluation was conducted to assess the outcomes of the Internet of Educational Things (IoET) products developed by the

teachers. This evaluation took the form of authentic assessment, which is a highly effective approach for measuring intellectual achievement or ability. Authentic assessment requires teachers to demonstrate deep understanding, higher-order thinking, and complex problem-solving skills through the performance of representative and relevant tasks (Koh, 2017). In the context of IoET, authentic assessment allows us to gauge the extent to which teachers can integrate the concepts and learning tools from the programme into their daily teaching practice. Teachers are tasked with designing assignments or projects that enable their students to apply the knowledge and skills acquired through IoET in real-world scenarios. This may involve the creation of technology projects, the development of Internet of Things (IoT) solutions, or other pertinent applications of creative ideas. In addition to assessing concept comprehension, authentic assessments also serve to identify teachers' ability to design challenging tasks and measure student progress in a meaningful manner. The results of these assessments serve as a valuable source of information for improving the IoET programme, identifying areas where teachers may require additional support, and ensuring the effective achievement of learning objectives. Therefore, authentic assessment plays a crucial role in measuring the success and positive impact of the IoET programme within the educational context of Wahid Hasyim Junior High School.

Internet of Educational Things (IoET). IoET is a conceptual framework that integrates Internet of Things (IoT) technologies within educational settings, with the aim of augmenting the teaching-learning process. These IoET applications encompass a diverse array of solutions and devices that are specifically designed to optimize the educational experience, as exemplified by the assortment of products showcased in Figure 6. The development of various IoET applications holds the potential to enhance teaching efficiency, augment student comprehension, provide real-time feedback, and foster a more interactive and personalized learning environment. Consequently, the integration of IoET applications within the realm of education exhibits significant promise in terms of elevating the quality of both teaching and learning.

The present study outlines a series of follow-up steps aimed at ensuring the sustainability and improvement of the Internet of Educational Things (IoET) programme at Wahid Hasyim Junior High School. Firstly, a comprehensive evaluation of the programme's outcomes is necessary to assess the extent to which the programme has achieved its learning objectives and its impact on student progress. Based on the evaluation results, learning materials should be updated and improved to remain relevant and support effective learning. Additionally, further training should be developed for teachers seeking to enhance their skills in integrating IoET into their daily teaching practices. This training could encompass the use of new tools, better teaching strategies, and innovative approaches to teaching.



To expand knowledge and experience, a learning community can be established among teachers involved in the IoET programme, facilitating collaboration and exchange of ideas. In addition to focusing on teacher development, specific programmes should be developed to engage students in the use of IoET. This could include technology project competitions, seminars, or clubs that encourage student creativity and innovation. Furthermore, programmes need to continuously monitor the impact of IoET on students, by measuring their progress in digital competence, material understanding, and higher-order thinking skills.

Expanding the scope of the IoET programme to other schools or partnerships with other educational institutions should also be considered to spread the benefits of IoET to more students and teachers. Finally, the publication of the results and best practices of the IoET programme to the wider education community can help inspire and assist other educators who want to adopt IoET in their learning. Thus, these follow-up steps are expected to ensure the sustainability and success of the IoET programme at Wahid Hasyim Junior High School.

CONCLUSION

The community service initiatives undertaken to establish the Internet of Educational Things (IoET) programme have demonstrated commendable progress in addressing the challenges faced by contemporary education, particularly within the context of Wahid Hasyim Junior High School. The creation of a programme that emphasizes the utilization of the internet as an educational resource, coupled with the provision of training and mentorship for educators, represents significant endeavors in advancing the field of education. The implementation of authentic assessment as a means of evaluation has also yielded valuable insights into the extent to which the programme has influenced educational practices within the school. Consequently, it is recommended that continued support and expansion of the IoET programme be pursued, with due consideration given to the evaluation findings in order to effect necessary improvements and adjustments. Furthermore, the adoption and extension of similar

programmes to other educational institutions would serve to maximize their positive impact on education within diverse communities.

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