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Workshop on IoT EDUTrainee Utilization to Enhance Competency of Vocational School Teachers in IoT Implementation

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ABSTRACT

This community service activity aimed to enhance the competency of vocational school teachers in the electro field across Bandung Raya by providing training on the utilization of IoT EduTrainer technology. The workshop followed the ADDIE model, covering both theoretical and practical aspects of IoT implementation, including case studies on smart greenhouse monitoring, RFID-based door locks, and automated watering systems. Participants engaged in hands-on activities, gaining practical experience in setting up IoT systems using Blynk and MQTT platforms. The evaluation revealed high participant satisfaction, with average scores of 83.5% for material quality, 81.75% for delivery methods, and 79.25% for practical activities. Although the workshop achieved its objectives, participants suggested allocating more time for hands-on exercises to improve their understanding and application of IoT concepts. This training equipped teachers with valuable skills for integrating IoT into their curricula, supporting the development of Industry 4.0-ready students.

Keywords*: IoT technology, vocational training, smart systems, educational innovation*

1. INTRODUCTION

With the growing interest in IoT and smart technologies among students, there is a pressing need for educators to be proficient in delivering up-to-date, industry-relevant content **(Haryoko et al., 2021)**. Vocational education plays a critical role in equipping the younger generation with the necessary skills for the modern workforce, particularly in fields that are evolving rapidly due to technological advancements. Among these fields, the Internet of Things (IoT) stands out as a crucial component that underpins many innovations in areas like manufacturing, energy management, and smart infrastructure **(Dasuki & Abdurrahman, 2023)**.

The IoT EDUTrainee system is an educational tool specifically designed to teach the core concepts of IoT technology, offering a hands-on approach to learning. IoT systems typically involve the integration of sensors, microcontrollers, and communication protocols (e.g., MQTT, Zigbee, LoRa), all of which allow for real-time data collection and remote management of devices **(Darso et al., 2023)**. This makes IoT an essential topic within technical and vocational education, particularly in the electro field. However, many teachers face challenges in understanding and applying these new technologies, as traditional curricula often do not keep pace with these rapid advancements.

The IoT EDUTrainee platform offers a comprehensive suite of tools that includes hardware components, like sensors and microcontrollers, alongside software interfaces that allow for data visualization and control **(Fauzan et al., 2024)**. By incorporating IoT EDUTrainee into vocational education, teachers can better illustrate how these systems work in real-world applications, thereby increasing the practical understanding of IoT among students.

This workshop is designed to address the competency gap by providing vocational school teachers in the Bandung Raya region with practical training on IoT EDUTrainee. The aim is to enhance their skills in implementing and teaching IoT technologies, enabling them to incorporate these advancements into their curriculum **(Sudrajat et al., 2022)**. By doing so, the workshop seeks to prepare both educators and students for the demands of Industry 4.0 and IoT-based careers, ultimately raising the standards of technical and vocational education in the region.

This training will also benefit the students by ensuring that teachers are equipped to offer engaging, practical lessons that foster a deeper understanding of IoT technologies **(Rizqulloh et al., 2021)**. Moreover, it will help prepare students for participation in national and international technical competitions, enhancing the overall reputation of vocational education in the Bandung Raya area.

2. METHOD

The implementation method for this activity followed the ADDIE instructional design framework (Figure 1), encompassing the stages of needs analysis, training approach design, material development, training implementation, and evaluation and updating. These steps involved identifying competency gaps in IoT knowledge among vocational school teachers, developing a curriculum centered on IoT EduTrainer modules, and creating practical case studies such as temperature and humidity monitoring for smart greenhouses, automated watering systems, and RFID-based door locks. The training was delivered through a combination of theoretical sessions and hands-on exercises using IoT EduTrainer kits, the Blynk platform for real-time monitoring, and MQTT for efficient communication between IoT devices. Evaluation was conducted through post-training surveys to gauge participants' satisfaction with the content, delivery methods, and practical activities, along with peer-to-peer evaluations to gather richer feedback **(Somantri et al., 2024) (Molenda, 2003)**.

This full-day workshop combined theoretical learning with practical, hands-on activities. The detailed event schedule is shown in Table 1. The workshop aimed to enhance the competency of teachers in utilizing IoT technologies, ultimately helping them prepare students for future IoT-based careers. Participants gained practical skills they could apply in their classrooms, including using the Blynk platform to control devices via a mobile app and utilizing MQTT for real-time device communication. Thus, the training is expected to contribute to the overall improvement of vocational education quality in the Bandung Raya region.

Figure 1. Illustration of the ADDIE Method

Table 1. Event Rundown Community Service

No.	Event Description	Duration
1	Registration	30 minutes
2	Opening	10 minutes
3	Explanation of IoT EduTrainer using PowerPoint	15 minutes
4	Project 1: Implementation using MQTT	50 minutes
5	Break	10 minutes
6	Project 2: Implementation using Blynk	45 minutes
7	Break	10 minutes
8	Project 3: Further Implementation using MQTT	50 minutes
9	Lunch Break (Isoma)	50 minutes

3. RESULT AND DISCUSSION

This section provides an overview of the findings from the workshop on IoT EDUTrainee Utilization, summarizing the activities, evaluations, and insights gained from the training. The discussion highlights the effectiveness of the program and the areas for improvement based on participant feedback.

3.1 Preliminary Preparation

The preparation phase was an essential part of ensuring the success of the *IoT EDUTrainee Workshop* aimed at enhancing the competency of vocational school teachers in the electro field across Bandung Raya. This phase involved several key activities that set the foundation for a smooth execution of the training, including curriculum design, participant recruitment, and logistical arrangements.

3.1.1 Planning and Design of the Training Program

The workshop was carefully planned to address the specific needs of the participants—teachers in the electro field—by providing practical, hands-on training with IoT systems. The program focused on utilizing the IoT EDUTrainee platform, which is designed for easy implementation of IoT projects in educational environments. The training team held several meetings to define the workshop's objectives, identify key learning outcomes, and determine the appropriate methods for delivering the content. The goal was to ensure that the workshop provided both theoretical knowledge and practical experience in IoT.

3.1.2 Invitation and Recruitment of Participants

To ensure maximum participation, invitations were sent to vocational schools (SMKs)

specializing in electronics and electrical engineering throughout the Bandung Raya region. Schools were selected based on their alignment with the workshop's objectives and the relevance of IoT technologies to their teaching programs. Invitations were distributed over two days, as shown in Table 2, to ensure ample time for participants to prepare.

Table 2. Schedule of Invitation Letter Distribution

No.	August 5, 2024	August 6, 2024
1	SMKN 1 Majalaya	SMKN 8 Bandung
2	SMKN 1 Cimahi	SMKN 6 Bandung
3	SMKN 1 Soreang	SMKN 7 Baleendah
4	SMK TI Pembangunan Cimahi	SMKN 4 Bandung
5	SMKN 1 Cipatat	SMKN Katapang

3.1.3 Curriculum Development

A significant portion of the preparation phase was dedicated to developing a curriculum that would provide teachers with comprehensive knowledge and practical skills in IoT. The curriculum focused on real-world IoT applications, including Temperature and Humidity Monitoring, RFID-Based Door Lock Systems, and Automated Watering Systems, which are relevant case studies that can be implemented in vocational schools. The topics covered in the workshop were designed to equip teachers with the skills to integrate IoT technologies into their own teaching and to provide students with a strong foundation in these emerging technologies. The finalized curriculum, including topics and allocated instructional time, is outlined in Table 3.

Table 3. STM32 Training Curriculum

No.	Material	Instructional Hours
1	Introduction to Microcontrollers and IoT	2 JP
2	Introduction to IoT EduTrainer Products	2 JP
3	Installation and Configuration of Supporting Software	4 JP
4	Basic Programming with IoT EduTrainer	4 JP
5	Case Study: Monitoring Temperature and Humidity	5 JP
6	Case Study: RFID-Based Door Lock System	5 JP
7	Case Study: Automated Watering System	5 JP
8	Case Study: Smart Green House	5 JP
Total	**Total Instructional JP**	**32 JP**

3.1.4 Logistical Arrangements

Logistical preparations were key to ensuring the smooth running of the workshop. The venue was selected based on its suitability for hands-on IoT activities, and the necessary equipment, such as IoT kits, computers, projectors, and other teaching aids, was organized and tested in advance. Arrangements were also made to ensure participants had access to the necessary materials, including pre-installed software and IoT EduTrainer kits for each participant. Catering and transportation logistics were also finalized to support participants throughout the workshop day.

3.2 Implementation of Training

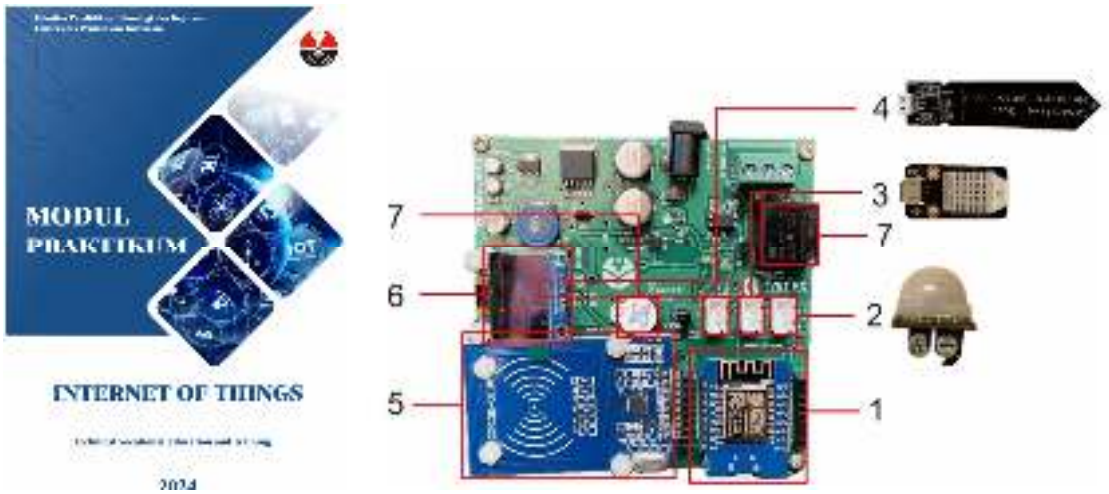
The workshop took place on Thursday, August 8th, 2024, beginning with the display of the PKM Workshop Banner at the venue entrance. The banner clearly outlined the theme of the workshop: *"Utilizing IoT EduTrainer to Enhance the Competency of Vocational School Teachers in the Electro Field Across Bandung Raya."* It set the tone for the event and provided a professional and welcoming atmosphere for participants (Figure 2).

Figure 2. PKM Workshop Banner at The Event Entrance, Highlighting the Theme and Objectives of The Iot Edutrainer Workshop

Once participants gathered, the Head of Community Service delivered an opening speech. Standing in front of the workshop banner, the Head outlined the importance of integrating IoT into vocational school curricula, emphasizing the role of this workshop in equipping teachers with the skills necessary for this technological shift. The speech set clear expectations for the day's activities and motivated participants to engage deeply with the materials (Figure 3).

Figure 3. Head of Community Service Delivering the Opening Speech

After the opening speech, each participant was given a Training Module Book. This comprehensive guide provided essential reading material, step-by-step tutorials on IoT setups, and instructions for completing practical exercises. The module also contained case studies, which the participants would be working on during the hands-on sessions, ensuring they had all the information they needed in one place (Figure 4a).

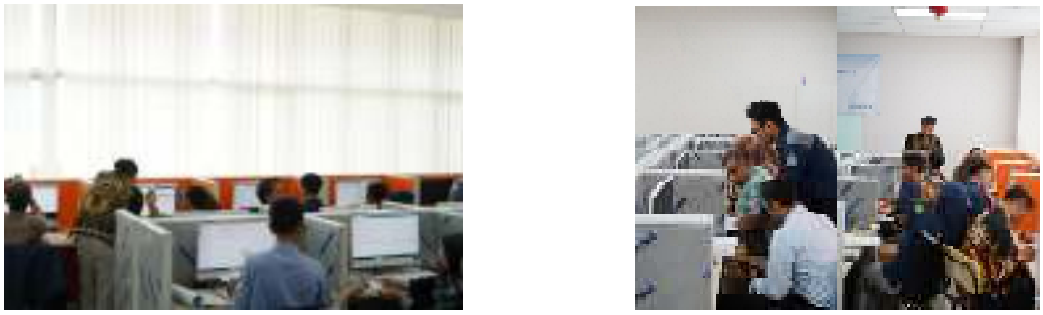


(a) (b)

Figure 4. (a)Training Module Book (b) IoT EduTrainer kits

The first technical session introduced microcontroller and IoT technologies using the IoT EduTrainer platform, emphasizing the relevance of IoT in modern vocational training. A brief Q&A session allowed participants to clarify concepts before beginning their hands-on work. In the second session, participants unboxed their IoT EduTrainer kits and, with guidance from facilitators, successfully set up their IoT systems. As shown in (Figure 4b), the kit includes several key components: (1) an ESP32 microcontroller for data processing and IoT connectivity, (2) a PIR motion sensor for detecting movement, (3) a DHT11 sensor for temperature and humidity monitoring, (4) a capacitive soil moisture sensor for agricultural applications, (5) an RFID module for access control systems, (6) an OLED display for real-time data visualization, and (7) a relay module for controlling external devices like actuators or pumps. These components were demonstrated and configured during the session, helping participants understand their practical applications in IoT projects.

In the Basic Programming with IoT EduTrainer session, participants learned how to program their IoT setups using the Blynk and MQTT platforms. These platforms enabled real-time monitoring and communication between devices. Teachers were guided through creating simple programs and setting up systems for temperature and humidity monitoring, using the IoT kits provided (Figure 5a).



(a) (b)

Figure 5. (a) Programming Session with Participants (b) Participants Engaging in The Temperature and Humidity Monitoring Case Study during The Hands-On Session

During the practical sessions, participants explored IoT technology through hands-on case studies. In one example (Figure 5b), they used a DHT11 sensor to measure temperature and

humidity, transmitting data to a user-friendly IoT platform for real-time analysis. This activity demonstrated the practical application of IoT in areas such as smart agriculture. Other case studies, including RFID-based door locks and automated watering systems, provided further insight into IoT's potential in security and automation. These exercises helped participants build confidence in IoT integration, enhancing their skills for vocational education curricula.

After completing the hands-on exercises, participants reconvened for a reflection session, where they shared insights, discussed challenges, and received guidance from facilitators. The Head of Community Service then delivered a closing speech, highlighting the importance of the skills learned and thanking participants for their active involvement. The workshop ended with a group photo in front of the PKM Workshop Banner, marking the successful completion of the event (Figure 6).

Figure 6. Group Photo Session After The Completion Of The IoT Edutrainer Workshop, with The PKM Banner in The Background

3.3. Evaluation

At the end of the workshop, participants completed surveys to evaluate the training's effectiveness and their satisfaction. The surveys assessed three main aspects: content quality, delivery method, and practical activities, using a Likert scale from 1 (Strongly Disagree) to 4 (Strongly Agree). The results were categorized into satisfaction levels, with a focus on positive feedback as the key measure of success, as shown in Table 4.

Table 4. Participant Satisfaction Range

No.	Percentage (%)	Description
1	81.26 – 100.00	Very Satisfied
2	62.51 – 81.25	Satisfied
3	43.76 – 62.50	Unsatisfied
4	25.00 – 43.75	Very Unsatisfied

Participants were considered satisfied if their responses fell within the 62.51% to 81.25% range, while a percentage exceeding 81.26% indicated a very high level of satisfaction. With 20 participants completing the evaluation, the maximum possible score was 80 (if every participant selected "Strongly Agree" for all questions), while the minimum score was 20 (if every participant selected "Strongly Disagree").

The evaluation form covered three main aspects: the content of the material, the delivery of the material, and the practical demonstration activities. Below are the detailed findings of the evaluation.

A. Content of the Material

Participants were asked several questions regarding their satisfaction with the substance and relevance of the material. For example, one of the questions posed was: "Was this workshop engaging for the participants?" This question received a high satisfaction rate of 84%, indicating that the workshop content was highly engaging. The overall satisfaction score for the content of the material was 83.5%, which suggests that participants were very satisfied with the material and found it to be relevant and well-organized, as detailed in Table 5.

Table 5. Content Quality Questionnaire

Content Aspect	Percentage
The training theme is interesting to me	84%
The material provided is relevant to my needs	80%
The material is well-organized and structured	87%
The material is presented clearly and easy to understand	83%
Average	**83.5%**

The data from Table 5 demonstrates that participants felt the material was well-organized, with 87% agreeing on this aspect. Additionally, 84% of participants found the theme interesting, while 80% felt the material met their specific needs.

B. Delivery of the Material

Participants also evaluated the instructor's ability to effectively deliver the material. Several questions were asked regarding the instructor's knowledge of the material, the time allocation, and the clarity of presentation. The results from the responses showed an average satisfaction rate of 81.75%, indicating that participants were very satisfied with how the material was delivered, as detailed in Table 6.

Table 6. Delivery Method Questionnaire

Delivery Aspect	Percentage
The instructor has a deep understanding of the material	85%
The instructor's time allocation was sufficient	82%
The instructor conveys the content clearly and understandably	83%
The instructor facilitates discussions and provides feedback	77%
Average	**81.75%**

The results from Table 6 reveal that participants highly valued the instructor's expertise, with 85% agreeing that the instructor had a deep understanding of the material. Participants also appreciated the clarity of the presentation, with 83% expressing satisfaction. However, the score for facilitating discussions and providing feedback was slightly lower at 77%, suggesting a minor area for improvement.

C. Practical Activities

The final aspect of the evaluation focused on the hands-on practical activities. Participants were asked about the ease of using the provided modules, the quality of the modules, and the overall experience of the practical sessions. The average satisfaction score for this section was 79.25%, which indicates that participants were satisfied with the practical activities, although there may be room for improvement, particularly in the allocation of time for these sessions, as shown in Table 7.

Table 7. Practical Activities Questionnaire

Practical Activities Aspect	Percentage
The provided modules were of good quality	79%
The provided modules were easy to understand	82%
The assistant instructors facilitated the practical activities well	83%
The time allocated for the practical sessions was sufficient	73%
Average	**79.25%**

From Table 7, the results highlight that ease of understanding the modules received a high score of 82%, and the assistance provided by the instructors was well-regarded, with a satisfaction rate of 83%. However, time allocation for practical sessions received the lowest score of 73%, indicating that participants felt the need for more time to complete the exercises effectively.

3.4 Discussion

The workshop provided meaningful insights into IoT teaching using the IoT EduTrainer platform. It applied constructivist principles by engaging participants in hands-on exercises to internalize IoT concepts. In line with adult learning theory **(Knowles, 1984)**, the workshop offered practical, relevant content and encouraged active participation, fostering collaborative problem-solving. Emphasizing lifelong learning **(Field, 2000)**, it helped educators stay updated with IoT advancements, enhancing their ability to prepare students for future challenges. Overall, the workshop effectively combined educational theories and practice, though future iterations could improve content and delivery to further enrich learning outcomes

4. CONCLUSIONS

The IoT EduTrainer Workshop successfully enhanced the competencies of vocational school teachers in the electro field across Bandung Raya by providing comprehensive training in both theoretical and practical aspects of IoT technology. Evaluation results showed high levels of satisfaction, with participants rating the material quality at 83.5%, the delivery methods at 81.75%, and the practical activities at 79.25%. These results highlight the effectiveness of the workshop in achieving its objectives. However, feedback indicated the need for more time in practical sessions to ensure a deeper understanding of IoT implementation. Future workshops should consider extending the duration of hands-on activities and incorporating additional case studies to further enrich participant experiences. Overall, this workshop provided teachers with the skills necessary to implement IoT technologies in vocational education, preparing students for Industry 4.0 demands.

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