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Application of the Internet of Things in Waste Processing Equipment for Batik Craftsmen in Iroyudan Village, Guwosari Village, Pajangan District, Bantul Regency

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ABSTRACT

Yogyakarta is one of the largest batik-producing cities in Indonesia. It has a positive impact on the artisans's economy. It adds new jobs, but this has yet to be matched by the skills and knowledge of the artisans in managing liquid waste generated from batik activities. So far, liquid batik waste has been stored in holding tanks and allowed to seep into the ground or even directly thrown into the water without further processing. So, it harms the environment, such as pollution of the waters and the surrounding environment and even the death of aquatic biota. Therefore, a renewable technological innovation was created, combined with the Heterogeneous Fenton method as a medium for processing batik waste. The methods used include pre-test, lecture, question and answer and post-test. Based on service activities that have been carried out, including providing information on equipment technology of batik waste processing to batik artisans in Desai Iroyudan, Guwosari Village, Pajangan District, Bantul Regency, Yogyakarta, it is known that the level of community understanding has become 98% or increased by 23%.

Keywords: Internet of Things; Batik Waste; Waste treatment; Heterogeneous Fenton

INTRODUCTION

The batik industry is an industry that continues to develop over time. One of the problems that is still of concern today is batik industry waste, especially the dye content contained in batik dyes (Hakim & Adhy, 2020; Indrayani, 2019; Siregar et al., 2020; Susanti et al., 2022) . Reactive dyes negatively impact the environment if they are not appropriately processed, such as polluting the waters and surrounding environment and even killing aquatic biota. So far, liquid batik waste has been stored in holding tanks and allowed to seep into the ground without any further processing (Indrayani, 2021; Jannah & Muhimmatin, 2019; Khasna, 2021; Pangestuti et al., 2021) . Considering the impact of batik dyes on the environment, several efforts must be made to minimize these impacts before being discharged into the waters. A batik waste processing method is being developed, namely the Heterogeneous Fenton method, which can degrade batik waste into compounds that are not harmful to the environment.

The method of implementing service is carried out using socialization/introduction related to the program that will be implemented together with service partners and training, introduction to technology, use of tools, and transfer of science and technology to service partners. The urgency of this proposal is that technological innovation was created in the form of liquid waste processing technology based on the Internet of Things (IoT)

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combined with the Heterogeneous Fenton method as a medium for processing batik waste. The batik waste processing technology was created using ESP32 as a microcontroller and ESP32-CAM as a degradation process monitor. This tool utilizes the internet network to send data over long distances via a WiFi signal connected to the system. So users can immediately confirm whether the waste is ready to be discarded. It is also equipped with sophisticated components in which the waste processing process can be monitored in real-time via a smartphone so that users are more efficient with their time to carry out other activities.

Partners in this community service are the people of Iroyudan village, Guwosari, Kec. Pajangan, Bantul Regency, Yogyakarta. Based on the objectives and identification of problems in this PKM, the target of its activities is batik artisans. The results of initial observations at the location show that generally the batik craftsman community in Iroyudan Village still needs to learn the use and application of IoT, especially its application to waste processing. Apart from that, village people, especially batik artisans, have yet to learn IoT technology. Even though rural communities are internet users, almost all of them have not received knowledge about the Internet of Things. So, currently, batik processing is still done manually. The urgency applied to this training is that most residents working as batik artisans can increase their time efficiency at work and monitor the waste processing process remotely.

MATERIALS AND METHODS

This community service activity will take place on Saturday, September 16 2023 from 08.00 – 12.00 WIB at one of the Batik artisans' residences, CV Erisa Batik. The targets of community service are batik artisans in Iroyudan Village, Guwosari Village, Pajangan District, and Bantul Regency. The method used in this community service activity is

1. Pre-test. The pre-test was conducted to determine how much the public understood before the material was presented.
2. The lecture conveys material about the definition of the Internet of Things (IoT), current IoT applications, tool forms and tool working principles.
3. Questions and answers are to discuss the material presented so that there is a reciprocal interaction between the participants and the participants and between the participants and the presenters.
4. Post-test. The post-test was carried out to assess the increase in public understanding after the material was delivered and as an instrument for measuring the success of delivering the material.

RESULTS AND DISCUSSIONS

This service activity was carried out on Saturday, September 16 2023, located at one of the residences of batik craftsmen, namely CV Erisa Batik with batik artisans partners in Iroyudan Village, Guwosari Village, Pajangan District, Bantul Regency, Yogyakarta.

Figure 1. Activities of Providing Knowledge

This activity takes place from 08.00 – 12.00 WIB. Participants who have attended are required to fill in the attendance list, pre-test and post-test, as proof of activity data. Participants must fill in their full name, address and signature in the columns provided. Participants are invited to sit down first before the training event begins. This Community Service also collaborates with lecturers and students from Electrical Engineering and Chemical Engineering. The service activity began with remarks from the chief executive and representatives of batik artisans. The things conveyed by the chief executive included an introduction to the PKM team and the aims and objectives of carrying out the activities. The method applied in this community service is the lecture method and question and answer discussion. Delivery of service material begins with filling out a questionnaire instrument before the activity (pre-test) to determine the participant's level of understanding before the counselling is carried out. The results of the pre-test carried out by the community showed that all artisans were able to use the Internet. However, artisans did not yet know the definition of IoT and the application of IoT. Therefore, this community service also urgently needs to increase public knowledge about the Internet of Things (IoT).

The core activity begins by providing education about technological developments, especially the definition of IoT and the application of IoT in today's world. The Internet of Things is a concept where an object or object is embedded with technologies such as sensors and software to communicate, control, connect and exchange data through other devices as long as they are still

connected to the Internet (Istiyono et al., 2023; Rahmanto et al . al., 2022; Sakinah et al., 2022; Suharto et al., 2022). IoT technology has been applied in several human jobs (Candra et al., 2023; Irawan et al., 2023; Windihastuty, 2021), including

1. Smart Cities. Helping effective city management through sensors in real-time
2. Smart Traffic. Analyze motor vehicle traffic on the road
3. Security & Emergencies. Detect radiation and explosive gases
4. Home Automation. Monitor water usage, TV, doors, windows and plant waterers
5. Smart Mall. Detecting the presence of visitors to a mall
6. Retail. Monitor delivery of goods and view expiration dates
7. Smart Agriculture. Detect soil moisture, air, and temperature for agriculture
8. SmartEnvironment. Detect forest fires, air pollution, and early detection of earthquakes/tsunamis.

The aim of applying technology in various fields is so that humans as users can retrieve information on all objects or devices at any time and anywhere so that they can then make decisions to take appropriate action (Adikara & Ramadhan, 2021; Darto et al., 2021; Hidayat et al., 2021; Hidayat et al. ., 2022) . Every object or device has sensors and network capabilities that enable it to communicate with each other, access internet services and interact with humans (Gultom et al., 2019) . There are several devices needed to implement IoT, namely

1. Censorship. Functions as a receiver/collector of information about what to monitor, for example, a temperature sensor to get temperature information, a warm sensor to get detected colour information, a pH sensor and others.
2. CPU/Computer. The computer on this page does not have to be a laptop. To make an IoT device, a small computer is often called a single-board computer (Arduino).
3. Communication Line. After the sensors collect information and the CPU processes and determines actions based on the information received, IoT devices need a communication path to send data.
4. Output/Output. It is an action from a program installed on the CPU, such as sending information to the central server if certain conditions are met, moving a stirrer, turning on lights, sounding an alarm, displaying data, etc.

The material continues with material about batik waste processing equipment. The batik waste processing tool is designed to use an intelligent system for processing batik waste, which is carried out automatically by the tool. The principle of this tool is that the reactor takes images by ESP32-CAM. Then, the image is sent from the ESP32-CAM to the smartphone, which can be monitored by the user in real-time. Figure 2 is the working principle, and Figure 3 is the product design for batik waste processing equipment.

Figure 2. Working Principle of Batik Waste Processing Equipment

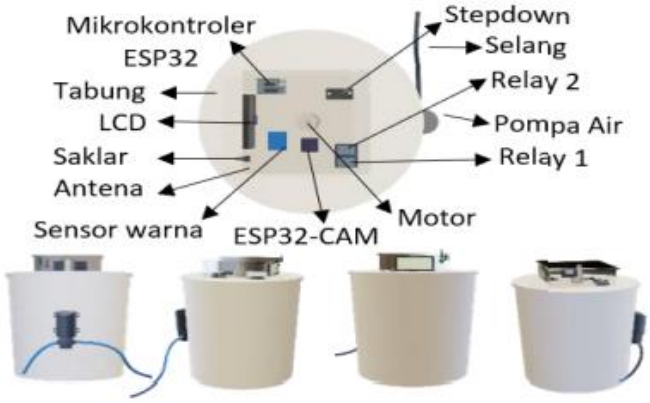

Figure 3. Design of Batik Waste Processing Equipment

At the end of the activity, participants fill out a questionnaire instrument (post-test) to determine their level of understanding of the participants after following the counselling. In order to find out the impact that the community has received from implementing this service activity, the assessment evaluation is carried out by comparing the results of the pre-test and post-test with the theme of the questionnaire questions shown in Table 1. The results of the pre-test and post-test assessments are shown in Figure 4.

Table 1. Themes of pre-test and post-test questionnaire questions

Question to	Question Theme
1	Internet user
2	The term IoT stands for
3	Definition of Internet of Things
4	Application of the Internet of Things
5	Purpose of using the Internet of Things
6	Examples of implementing the Internet of Things
7	Components of batik waste processing equipment
8	Working principle of colour sensors
9	Benefits of using waste processing equipment
10	Participants' interest in gaining knowledge about IoT

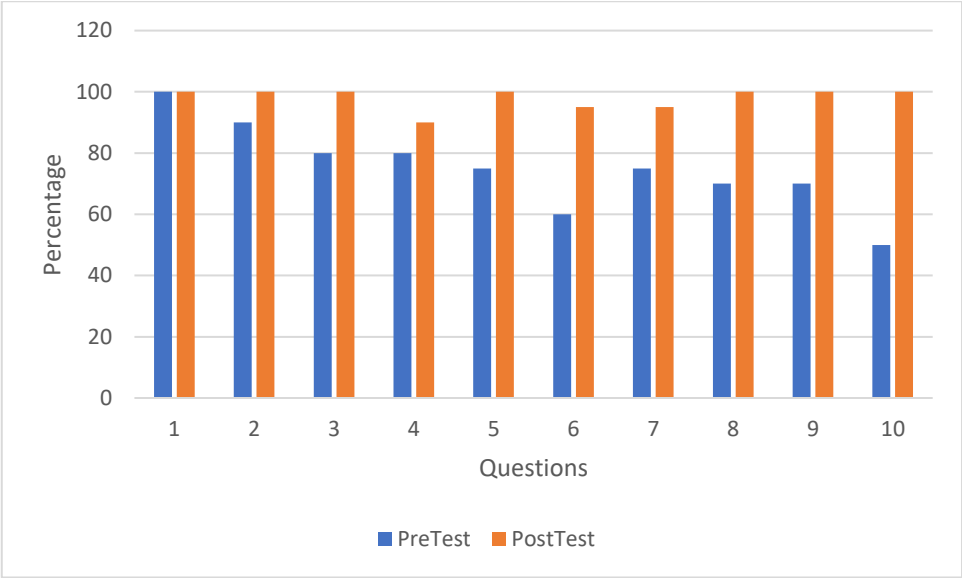

Figure 4. Evaluation based on pre-test and post-test

Based on the evaluation results, the average understanding of service activity participants has increased. Information was obtained that all participants present were internet users, which was reflected in question number 1. Knowledge about the abbreviation for the term IoT in question number 2 and the application of the Internet of Things in question number 4 increased by 10%. Question number 3 regarding the definition of the Internet of Things and components of waste processing equipment increased in question number 7 by 20%. Meanwhile, number 5, regarding understanding the purpose of using the Internet of Things and number 6, regarding examples of implementing the Internet of Things, experienced an increase of 25% and 35%. In questions number 8 and 9, the level of public understanding increased after following the counselling by 30%. In item number 10, it can be seen that participant interest has increased by 50%. Based on the average calculations, the level of community understanding before participating in this service activity was 75%. After participating in community service activities, the level of community understanding became 98% or an increase of 23%.

CONCLUSIONS AND RECOMMENDATIONS

Based on service activities that have been carried out, including providing information on equipment technology of batik waste processing to batik artisans in Desai Iroyudan, Guwosari Village, Pajangan District, Bantul Regency, Yogyakarta, it is known that the level of community understanding has become 98% or increased by 23%. These results indicate that the community service activities that have been carried out have been successful and have positively impacted the community who participated in this activity. The suggestion that can be given is that this service activity can be carried out continuously or sustainably.

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Conflict of Interests

The authors declared that no potential conflicts of interest with respect to the authorship and publication of this article.

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