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Training on the Use of Batik Waste Processing Equipment to Enhance Productivity for the Wijirejo Pandak Bantul Batik Group

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ABSTRACT

The batik industry is one that continues to develop over time. One of the ongoing concerns is the waste generated by the batik industry, particularly the dye content in batik dyes. Reactive dyes, if not processed properly, can have a very negative impact on the environment. They can pollute water sources, harm the surrounding environment, and even kill aquatic biota. Currently, liquid batik waste is stored in holding tanks and allowed to seep into the ground without further processing. Given the environmental impact of batik dyes, efforts must be made to minimize these effects before the waste is discharged into water bodies. A batik waste processing method currently under development is the Heterogeneous Fenton method. This method can degrade batik waste into compounds that are less harmful to the environment. The implementation of this service involves socialization and introduction of the program to the service partners, as well as training. This includes technology introduction, tool usage, and the transfer of scientific and technological knowledge to the service partners.

Keywords: Degradation ; Heterogeneous Fenton; Batik Industry, IoT; Batik Waste

INTRODUCTION

The batik industry is one of the economic sectors that continues to grow in Indonesia. However, waste generated from the batik dyeing process, particularly reactive dyes, remains a serious environmental issue. Reactive dyes are known to have a significant negative impact on the environment if not properly treated before being discharged into water bodies. This waste can cause water pollution and damage aquatic ecosystems, potentially threatening the survival of aquatic biota (Panggabean, 2019; Kusumaningrum, 2020). Currently, most of the liquid batik waste is merely stored in holding tanks and allowed to seep into the ground without undergoing adequate treatment (Setyawan & Ariyanto, 2021; Wijayanti, 2022). Given the negative impacts, it is crucial to develop effective waste processing methods to protect the environment.

Several waste processing methods have been developed to address this issue, with one promising approach being the Heterogeneous Fenton method. This method is effective in degrading harmful organic compounds present in batik waste, rendering them less hazardous to the environment (Prasetyo & Supriyanto, 2021). Its main advantage is its ability to treat a variety of pollutants with high efficiency, making it a viable solution for both large and small batik industries.

In addition to waste processing, digital technology plays a crucial role in the batik

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industry. Utilizing digital platforms for marketing batik products is a key solution, particularly for batik craftsmen groups in Wijirejo Village, Yogyakarta. Currently, marketing of batik products from this group is limited to local areas. The adoption of digital technology is expected to expand their marketing reach and enhance the competitiveness of their products (Hidayat & Pradipta, 2022; Astuti & Sudrajat, 2023) By leveraging digital technology, batik craftsmen can significantly increase the visibility of their products and access broader markets.

Previous training has explored various approaches to processing batik waste; however, the application of environmentally friendly technologies that are accessible to small and medium industries (IKM) remains limited (Wijayanti et al., 2020; Putra & Harjono, 2021). Many training programs focus on complex and costly methods, which may not always be practical for small-scale batik operations. Therefore, there is a need for waste processing methods that are not only effective but also practical and affordable for local batik craftsmen.

This training aims to introduce and apply the Heterogeneous Fenton method in a practical and effective manner for batik craftsmen in Wijirejo. This method is anticipated to offer a more affordable and easily implementable solution on a small scale. Additionally, the training will explore the integration of digital technology into marketing strategies, which is expected to create broader market opportunities for local batik products.

The contribution of this training is to provide a holistic solution that combines waste processing and digital marketing to enhance the sustainability and competitiveness of the batik industry at both national and international levels. This approach is designed to reduce the environmental impact of batik waste while boosting the industry's global market presence.

The training program involves the Batik Craftsmen Community Group from Wijirejo Village, Pandak, Bantul, as partners. Currently, the partners lack knowledge of effective waste processing methods and have not implemented proper waste management practices. This situation leads to environmental problems, such as water pollution and the death of aquatic biota, due to the improper disposal of batik waste. Liquid batik waste is typically collected in holding tanks and allowed to seep into the ground without processing, and some waste is directly disposed of into rivers through existing channels. Consequently, efforts are needed to minimize these negative impacts and protect the environment.

The focus of the training is to address environmental issues by implementing batik waste processing technology. This technology can effectively convert batik waste into water that can be reused in the batik production process. For this service program, the Batik Craftsmen Community Group from Wijirejo Village, Yogyakarta, has been proposed as a partner. Currently, the partner lacks knowledge of waste processing methods and has not implemented any industrial waste processing practices. As a result, batik waste is improperly disposed of, leading to environmental problems such as water pollution and damage to aquatic ecosystems, including the death of aquatic biota. At present, liquid batik waste is collected in holding tanks and allowed to seep into the ground without any treatment. Additionally, some waste is directly disposed of into rivers through existing water channels. To address these issues, it is essential to implement measures that minimize environmental damage and promote effective waste management.

MATERIALS AND METHODS

a. Socialization and Training on Batik Waste Processing Technology

In the initial stage, outreach was conducted to introduce waste processing technology and environmentally friendly wastewater quality standards to service partners. This socialization process involved conveying information through presentations, interactive discussions, and the

distribution of educational materials related to technology and environmental standards (Cahyono, 2020). Following this, intensive training on the technical skills needed to use waste processing equipment was conducted. This training included preparing teaching materials, conducting practical sessions, and providing technical guidance (Prabowo, 2021) Service partners were selected based on their relevance to the waste problem and their identified training needs. Participant understanding was evaluated through quizzes, feedback, and observations during training sessions to ensure the effectiveness of the training (Wibowo, 2022).

b. Application and Evaluation of Waste Processing Technology Tools

After the training, the next stage involves the independent application of waste processing technology tools by service partners, with ongoing technical support. This implementation aims to ensure that the technology is used in accordance with established standards (Susanto, 2021). Implementation procedures include providing technical support during the use of the equipment and monitoring the results of waste processing to ensure compliance with quality standards (Setiawan, 2022). Equipment selection criteria are based on the suitability of the equipment for specific waste processing needs and the partner's ability to operate it. The effectiveness of the implementation is evaluated by examining processing results and collecting feedback from partners to assess the success of the technology implementation (Sari, 2023).

c. Assistance, Evaluation, and Program Sustainability Plans

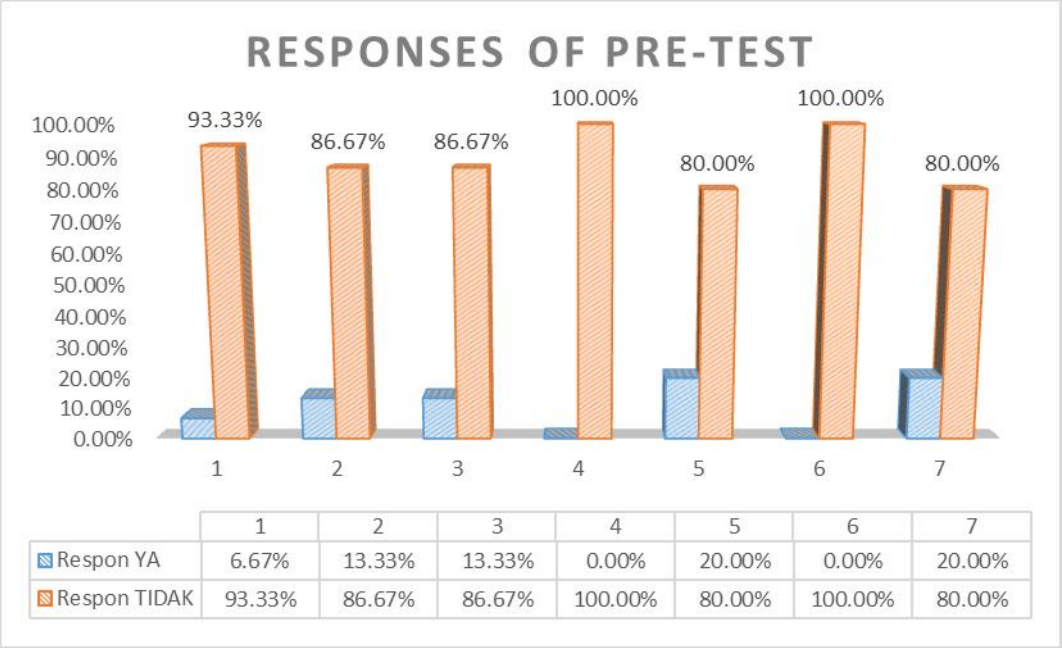
Assistance and evaluation are conducted to ensure that the application of technology and the use of digital platforms meet the stated objectives. Mentoring involves field visits to monitor implementation and analyze the results of using technology and platforms (Nugroho, 2021). Focus Group Discussions (FGDs) are held to plan and set sustainability targets for the program. These discussions involve key participants in formulating sustainability strategies (Kurniawan, 2022). This process includes collecting data and feedback on implementation and developing a sustainability plan based on the FGD outcomes. Evaluation criteria involve achieving the set targets and assessing the contribution of FGD participants to strategy formulation. The analysis technique compares the evaluation results with the targets and evaluates the sustainability strategy developed during the FGD (Hidayat, 2023).

RESULT AND DISCUSSIONS

This training activity was held at the Pijenan Residents' Building in Wijirejo, Bantul. The target audience for the training was batik craftsmen from the Wijirejo, Pandak, and Bantul sub-districts. The results from the pre-test and post-test indicate significant improvements in participants' understanding after receiving counseling and training on the use of batik waste processing equipment. Some of the questions addressed during the training are as follows:

Table. 1 List of Pre-Test and Post-Test Questions

No.	Questions
1	Do you know the dangers of waste?
2	Do you process batik waste before throwing it away?
3	Do you know the chemicals produced from batik waste?
4	Can you process batik waste independently?
5	Do you know the types of batik waste processing methods?
6	Do you know the method for processing batik waste using heterogeneous Fenton?
7	Do you know the tools and materials for processing batik waste with Fenton?



	1	2	3	4	5	6	7
Respon YA	6.67%	13.33%	13.33%	0.00%	20.00%	0.00%	20.00%
Respon TIDAK	93.33%	86.67%	86.67%	100.00%	80.00%	100.00%	80.00%

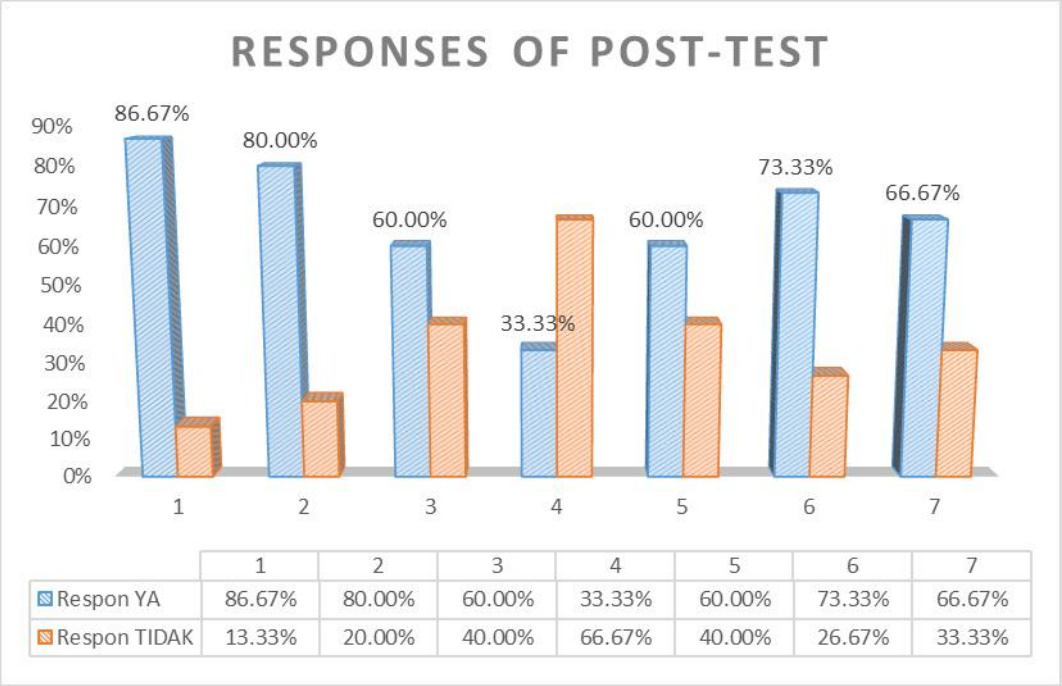
Figure 1. Evaluation based on Pre-Test results

The pre-test graph in Figure 1 provides an initial view of the participants' level of understanding before they engaged in counseling and training related to batik waste management. Overall, the graph shows that most participants had a very limited understanding of the topic. This is evident from the high percentage of "NO" responses to nearly all questions, indicating that the majority of participants were unaware of the dangers of batik waste, did not process the waste before disposal, and lacked understanding of the chemicals produced from batik waste. For example, 93.33% of participants answered "NO" to the first question, reflecting low awareness of the risks associated with batik waste.

Furthermore, the graph reveals that participants' knowledge about batik waste processing techniques is also very minimal. For the question regarding the ability to process batik waste independently, 86.67% of participants answered "NO," indicating that almost all participants lacked the skills or knowledge needed to process waste on their own. This underscores an urgent need to enhance their capacity and understanding of waste processing technologies and techniques that can be applied in daily practice.

In more specific aspects, such as knowledge about processing batik waste using the heterogeneous Fenton technique and the tools and materials required for the process, the graph shows extremely low results, with 100% of participants answering "NO" to these questions. This indicates that sophisticated or technical waste processing methods, such as the heterogeneous Fenton technique, were not known to participants before the outreach activities. This lack of understanding suggests that batik craftsmen in the area may still rely on less efficient traditional methods or may not process waste at all.

Overall, this pre-test graph reveals that, prior to the education, participants' knowledge regarding batik waste management was at a very low level. This highlights the importance of outreach and training programs to enhance participants' awareness and skills, enabling them to manage batik waste more responsibly and sustainably. The graph also serves as a crucial basis for evaluating the effectiveness of the service activities by comparing the pre-test results with the post-test results, which demonstrate an increase in understanding following the counseling activities.



	1	2	3	4	5	6	7
Respon YA	86.67%	80.00%	60.00%	33.33%	60.00%	73.33%	66.67%
Respon TIDAK	13.33%	20.00%	40.00%	66.67%	40.00%	26.67%	33.33%

Figure 2. Evaluation based on Post-Test results

The post-test graph in Figure 2 illustrates the increase in participants' understanding following their participation in outreach and training activities related to batik waste processing. Overall, the graph shows a significant improvement in participants' knowledge levels compared to the pre-test results. For most questions, there was a notable increase in the percentage of "YES" responses, indicating that participants gained a better understanding of various aspects of batik waste processing. For example, in the first question regarding the dangers of batik waste, 86.67% of participants answered "YES," reflecting a significant increase in awareness compared to the pre-test.

This improvement was also evident in the second question about processing batik waste before disposal, where 80% of participants answered "YES." This indicates that the counseling and training successfully enhanced participants' understanding of the importance of processing waste before disposal, an area that was previously poorly understood. The substantial increase in "YES" responses demonstrates that the interventions conducted during the outreach activities effectively equipped participants with relevant and practical knowledge.

Regarding more specific questions, such as the ability to process batik waste independently and knowledge of processing methods using the heterogeneous Fenton technique, the post-test graph shows a striking improvement. For instance, 60% of participants now report being able to process batik waste independently, and 66.67% understand the heterogeneous Fenton method. This represents a significant advancement compared to the pre-test results, where almost no participants were familiar with this method. This increase indicates that the training has been effective in introducing new technology to batik craftsmen.

Overall, this post-test graph indicates that the outreach and training activities have positively impacted participants' understanding of batik waste processing. The increase in the percentage of "YES" answers to almost all questions demonstrates that the program has successfully enhanced participants' awareness and skills in managing batik waste more effectively and in an environmentally friendly manner. These post-test results underscore the importance of such educational programs in helping the community, especially batik craftsmen, to better understand and implement sustainable waste processing practices.

Figure 3. Implementation of Training on the Use of Batik Waste Processing Equipment

Figure 3 documents the implementation of outreach and training activities related to the use of batik waste processing equipment. The activity began with educational sessions on the dangers of waste, particularly batik waste, and an overview of current batik waste processing methods. During these sessions, participants learned about the impact of batik waste on health and the environment. In addition, participants were informed about the importance of processing batik waste before disposal to mitigate environmental harm. The training session then involved hands-on practice with batik waste processing tools, utilizing the Fenton Heterogeneous method integrated with Internet of Things (IoT) technology.

CONCLUSIONS

Community service activities in Wijirejo, Pandak, Bantul, were successful and aligned with the expectations outlined in the "Introduction" chapter. The activities effectively increased public understanding in three main areas: batik waste processing, batik waste processing equipment technology, and the use of marketplaces. This demonstrates that the outcomes achieved were in harmony with the initial expectations.

a) **Increased Understanding of Batik Waste Processing:** The increase in understanding from 39% to 95% demonstrates the effectiveness of the activity in conveying the concept of batik waste processing to the public. This significant improvement aligns with the initial goal of enhancing awareness and skills in waste management.

b) **Increased Understanding of Batik Waste Processing Equipment Technology:** The increase in understanding from 40% to 98% indicates that the activity successfully met expectations in providing in-depth knowledge of waste processing technology. This significant improvement reflects the achievement of the goal to introduce and train participants in the effective use of waste processing equipment.

Based on the results and discussions, the following development prospects are recommended:

- **Continuous Application**: To ensure the sustainability of the knowledge gained, it is advisable to conduct service activities on an ongoing basis. Follow-up programs could include additional training, technical support, and periodic evaluations to maintain and enhance community understanding.
- **Development of New Technology and Methods**: Further research should focus on developing new technologies and more efficient methods for processing batik waste. This includes creating innovative and environmentally friendly tools.
- **Program Evaluation and Adjustment**: Conducting more in-depth evaluations of program effectiveness and gathering feedback from participants can help refine and improve future training curricula.

- **Expansion to Other Areas**: Future studies could extend the program to other regions with similar conditions to broaden its positive impact.

By implementing these steps, it is hoped that this service activity will continue to provide long-term benefits to the community and serve as a model for similar programs in the future.

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