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Development of Batik Motifs using Symatrig Application to enhance productivity and competitiveness of SMEs

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ABSTRACT

Developing Villages Index (IDM) of the North Padang Lawas Regency in 2023 remained underdeveloped. The status has been upheld since 2018, although many craft and tourism industries in North Padang Lawas Regency have the potential to contribute to the regional economy, one of which is batik small medium enterprises (SMEs). Batik SMEs in North Padang Lawas Regency are predicted to be the featured product of the regency. However, limited knowledge and resources in developing varied batik motifs have made the batik SMEs in this regency unpopular, both provincial and national. The Abdimas Team and partners, i.e., the Department of Industry and Trade of North Padang Lawas Regency, held training and coaching on the Symatrig computer application for 30 batik makers in the Regency to develop batik motifs based on mathematically symmetrical patterns. Of the 30 participants who attended the training, 50 percent were able to follow the activities well, and the remaining 50 percent were very good. In fact, 93.33 percent of participants strongly agreed to use Symatrig and 90.67 percent were optimistic that Symatrig could help their batik business. Batik makers also offer recommendations to continue conducting such activity to support those involved in the industry.

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1. INTRODUCTION

Motivation and Illustration of the Partner Conditions

Batik is an Indonesian cultural icon established as a Masterpiece of the Oral and Intangible Heritage of Humanity by UNESCO on 2 October 2009. It is a delight and an achievement for Indonesia and should be supported in its preservation and development. Batik has long been developed and evolved (Safitri et al., 2015; Tanjung et al., 2019; Trixie, 2020). Starting from the restricted circle of the palace (*keraton*), batik has developed into a creative industry commodity in Indonesia that breaches the global market. Contemporary varieties appear as a part of the batik evolution journey. Out-of-norm patterns are some of the adaptations of this Indonesian culture to survive and develop over time. From behind the restricted palace's wall, batik goes worldwide to be a glory of Indonesian cultural identity (Santosa, 2021). Today, batik is a typical formal and informal clothing in Indonesia, with promising potential in the industry.

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The high demand for batik will drive the potential of batik production to fulfill clothing needs (Qurrata et al., 2021). To date, there are 2951 batik industries recorded in Indonesia (Kementerian Perindustrian Republik Indonesia, 2024).

The activity partner in this regional partnership program is the Department of Industry and Trade of North Padang Lawas Regency (Department of Industry and Trade of Paluta Regency). The Department of Industry and Trade of Paluta Regency is a government agency in the Regional Government of Paluta Regency, North Sumatera Province. Paluta Regency was an expansion of South Tapanuli Regency in 2007. South Tapanuli was expanded to three regencies, i.e., South Tapanuli as the parent district with Sipirok as the capital, North Padang Lawas Regency with Gunung Tua as the capital, and Padang Lawas Regency as Sibuhuan as the capital. Several districts in each regency also experience expansion to support the regency development. The legal basis for the establishment of Paluta Regency is the Law of the Republic of Indonesia Number 37 of 2007, ratified on 14 August 2007 on the establishment of North Padang Lawas Regency, and the Law of the Republic of Indonesia Number 38 of 2007, ratified on 14 August 2007 on the establishment of Padang Lawas Regency. Drs. H. Arsyad was the acting regent, and Bachrum Harahap became the first regent of North Padang Lawas. Currently, Patuan Rahmat Syukur Parlaungan Hasibuan acts as the acting regent of Paluta. He was inaugurated on 27 November 2003 by the acting governor of North Sumatera, Hassanudin, at the Tengku Rizal Nurdin Hall, Governor's Official Residence, Medan City (Wikipedia, 2024).

Figure 1. North Padang Lawas Regency: (a) Regional map; (b) Department of Industry and Trade

Paluta Regency has 12 districts: Batang Onang, Dolok, Dolok Sigompulon, Halongonan, Halongonan Timur, Hulu Sihapas, Padang Bolak, Padang Bolak Julu, Padang Bolak Tenggara, Portibi, Simangambat, and Ujung Batu. The Village Development Index in 2023 revealed six underdeveloped and one highly underdeveloped district out of 12. Based on the same source, Paluta Regency became one of the six underdeveloped regencies from 2018-2023 in North Sumatera. The primary issues of underdeveloped regions are low human resource quality, minimal infrastructure, limited economic, information, and technological access, safety and disaster disruptions, and isolated border areas. Meanwhile, it is known that Paluta Regency is not an isolated border area. According to Syahza and Suarman (2013), one of the efforts to support people-based regional economy development is to develop micro, small, and medium enterprises by improving and developing the beneficial relationships and partnerships of such enterprises.

Through the Department of Industry and Trade of Paluta Regency, the Regional Government of Paluta Regency has tried to develop the local economy by providing moral and material coaching for small and medium business owners in Paluta. Numerous training activities are offered to improve the industry in North Padang Lawas and be known nationally. One of the Small-Medium Enterprises (SMEs) that have acquired attention from the regional government in recent years is batik. Moreover,

the Regional Government of Paluta Regency has designated a village as a batik tourism village, i.e., Sekar Najogi Tourism Village. The Sekar Najogi Tourism Village has become an icon of North Padang Lawas Regency for the batik center. Batik in Sekar Najogi has typical patterns illustrating beautiful Paluta Regency landscapes. Sekar Najogi batik is the most popular and sought-after product from Paluta Regency. There is also Aksara Paluta batik, which produces batik with characteristics of Batak alphabets as the motif.

Figure 2. Batik Paluta SMEs: (a) Sekar Najogi Batik; (b) Aksara Paluta Batik

Partner Issues

The Department of Industry and Trade of Paluta Regency struggles to assist batik makers in developing various batik motifs. All batik makers in Paluta Regency still manually create batik patterns. They usually feel trapped in existing patterns, and thus, it is challenging to experiment with new motifs. The monotonous batik motif is a critical problem for batik makers in Paluta Regency, particularly to captivate consumers. To date, most batik production in Paluta Regency is only favored locally. Limited variations in batik designs cause low interest from other consumers. Furthermore, limited time and resources also hinder batik makers in Paluta Regency from innovating. Despite their desire to create more intriguing work, many batik makers are not confident in exploring new ideas. On the other side, everchanging demands put pressure on creating varied creations. Therefore, the Regional Government of Paluta Regency expects a solution to this problem, allowing batik makers to produce batik in any motifs and compete globally. It is also possible that batik SMEs will drive the Paluta Regency IDM to improve its status to developing or developed.

The Proposed Solution

The crucial issue encountered by batik SMEs in Paluta Regency is the inability to develop batik with new or specially requested motifs. Using a suitable innovation, batik makers can create captivating works. Improving their visual appeal and motif uniqueness will help them to compete in the market. Through this activity, the team designed an application to help develop batik motifs. Digital batik motif development has recently been used by art workers or researchers in various fields. Digital techniques are preferred since they are quicker, easier, and more affordable in creating batik motifs than conventional ways. It then drives the team to develop a desktop-based GUI Matlab application using frieze and crystallography patterns to create numerous motifs. Frieze and crystallography patterns are mathematical concepts from repeated two-dimensional patterns, both one- or two-way translations. Based on (Panjaitan et al., 2022; Silalahi et al., 2022; Suwanto et al., 2022), traditional cloths in Sumatera, such as ulos, songket, and batik, have frieze and crystallography patterns in their motifs. These pattern concepts are used to develop two-dimensional motifs (Mingka et al., 2023; Nataliani, 2022).

Using the designed application, the team hopes that batik makers can produce and develop new, innovative, and varied batik motifs in a shorter period. The innovation and diversity in motifs will enhance consumer interest in the market and the economy of batik makers. Innovations in batik designs will enrich cultural heritage and increase sales. With these actions, batik is expected to be seen again by consumers. Simplifying the production of new batik motifs is anticipated to make batik makers in Paluta Regency productive in creating various batik types and competing with batik makers outside the city or on the national scale.

2. METHODS

In developing varied and captivating batik motifs, this service activity focuses on utilizing a computer application based on GUI Matlab. Technological advances enable batik makers to explore new designs more efficiently and creatively. The computer application allows them to create complex and diverse motifs. Hence, it solves the limitations often encountered in manual techniques. Also, using design software can help batik makers understand changing market trends and consumer preferences. A specially designed training program will provide skills for batik makers to use this technology. Thus, they can produce more innovative works. This approach can help batik makers improve their products' quality and expand the appeal of batik to youths. The integration of traditions and technology is the key to maintaining the relevance of batik in this modern era.

This activity is planned to be held in Hall Department of Industry and Trade of Paluta Regency and will be attended by all batik makers in Paluta Regency, approximately 30 batik makers. The activity comprises four stages, i.e., preliminary, preparation, implementation, and follow-up. The stages are explained in Figure 3.

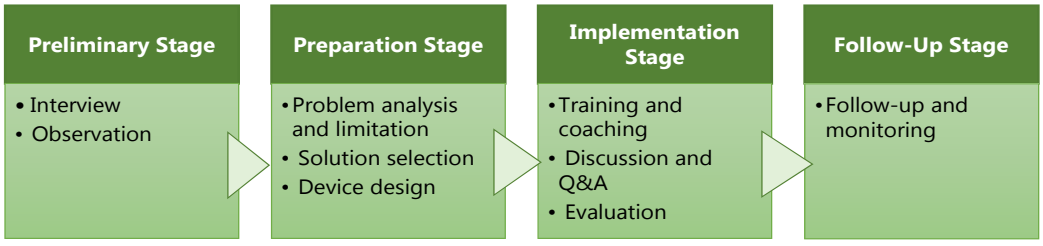

Figure 3. Stages of the activity

Preliminary Stage

In this stage, the team communicated with the Department of Industry and Trade of Paluta Regency to collect all information required regarding the partnership. As a part of this stage, the team interviewed one of the Department of Industry and Trade of Paluta Regency staff. In the interview, the team searched for information concerning the production and activities of batik SMEs in Paluta Regency. The interview revealed a clear and detailed illustration of the situation, challenges, and potential of batik SME development in the region, which will become the base for formulating strategic steps in supporting and developing this field.

Preparation Stage

Problem analysis and limitation

After conducting the interview and observation, the team managed to identify various problems faced by partners in the Department of Industry and Trade in Paluta Regency. Besides collecting data, the

team analyzed each problem to understand the root cause. Based on this analysis, the team determined problem limits and prioritized urgent issues with the most significant impacts on the partners. Therefore, the team could focus on the solutions that provide maximum benefits and support the performance and sustainability of their business.

Solution selection

In this step, the team designed a suitable alternative solution to solve partners' issues by developing a computer application based on GUI Matlab. This application was designed to help batik makers develop batik motifs and acted as an efficient and practical tool for batik makers to create various and innovative batik designs.

Activity device design

In this step, the team designed a guidebook for Symatrig application utilization to help batik motif development. The guidebook aims to facilitate participants in understanding how the application works, along with the explanation conveyed by the source person during training. This book would be distributed to all participants so that they could refer back to the information delivered and master the application more easily. In this step, the team also designed a questionnaire on application use satisfaction. This questionnaire was distributed at the end of the activity.

Implementation Stage
Training

In this step, the team conducted socialization, training, and coaching for the computer application used to develop motifs. The team divided the activity into several sessions to deliver all materials in a structured and prompt way.

Discussion and Q&A

After the application use demonstration and trial of motif development by batik makers, the team and batik makers opened a discussion and Q&A session concerning the activity. The problems encountered by batik makers during the development process were solved in this step so that they could independently use the application in their batik gallery.

Activity evaluation

The team evaluated participants' skills after training by distributing a questionnaire in this step. This evaluation aims to measure the extent to which the participants understand the materials and master the skills. If the questionnaire shows that the skills have not met the minimum target, the team will conduct follow-up training to ensure all participants achieve the standard.

Follow-Up Stage

In this stage, the team continued to monitor and assist batik makers in Paluta Regency. New problems would be discussed, and recommendations from the follow-up activity were collected. The team also motivated batik makers to produce batik motifs created during training using the application.

3. RESULTS AND DISCUSSION

Initial discussion with the Department of Industry and Trade of Paluta Regency

In this meeting, the Department of Industry and Trade of Paluta Regency informed the regional needs and potentials, while the service team offered support through relevant training, coaching, and

innovation programs. An interview with a staff member of the Department of Industry and Trade (see Figure 4) disclosed that batik makers in Paluta Regency are relatively proficient in producing hand-drawn and stamped batik after attending special training. However, the challenge is to develop new fascinating motifs. Typical batik motifs of Paluta remain inspired by other general motifs. The staff acknowledged that the batik produced from Paluta Regency is still marketed locally, and only some are going nationally. It might be caused by the limited appeal of Paluta batik motifs in the market. This open and constructive dialog is expected to generate strategic steps to support local economic growth, increase local product competitiveness, and create jobs for local people.

Figure 4. Initial discussion with partners

Figure 5. Symatric Screen: (a) Main screen; (b) Frieze cloth; (c) Crystallography textile

Activity Device Design

This activity resulted in a computer application based on GUI Matlab called "Symatrig." The motif development patterns attached to Symatrig were developed based on the symmetrical group theory concept in mathematics applicable in decorative arts, i.e., frieze and crystallography patterns. The main screen of Symatrig is depicted in Figure 5(a). The main screen has the application's name and symbol, developer's logo and institution, exit application button, and two main menus for motif development, i.e., "Frieze Cloth" to develop motif using frieze patterns and "Crystallography Textile" created by crystallography patterns. Clicking the Frieze Cloth button on the screen will show Figure 5(b). Meanwhile, clicking Crystallography Textile will show Figure 5(c). On the left side of the screen (see Figures 5(b) and 5(c)), images of traditional cloths from various tribes in North Sumatera are attached. The team added this feature to offer references for users when developing motifs typical of North Sumatera. The "Browse" button acts to insert other images from the device. Two screens display the selected image from image cutouts from the "Crop Image" process. "Home Menu" will take users back to the main screen. On the right side of the screen (Figure 6(a)), there are "Pattern 1, Pattern 2, Pattern 3, Pattern 4, Pattern 5, Pattern 6, and Pattern 7" buttons, the frieze patterns to create one-way images

(vertical or horizontal). Meanwhile, on the right side of the screen (Figure 6(b)), there are "P1, P2, PM, PG, P4M, CM, PMM, PMG, PGG, CMM, and P4" buttons, the crystallography patterns to create two-way images (vertical and horizontal).

Figure 6 shows the processes of image selection, image cropping, and motif development using Frieze Cloth and Crystallography Textile. Images from motif development using Symatrig can be saved in the device used using .jpeg format.

Figure 6. Motif development process using Symatrig

Training and Coaching of Symatrig Application Use

The training and coaching activity was officially opened by the Chief Executive and Acting Regent of Paluta Regency, represented by the Expert Staff for Economics, Finance, and Development at the Regional Secretariat of Paluta Regency. In his speech, the Chief Executive stated that this training aims to deliver new skills to batik SME owners in Paluta Regency in developing more innovative batik motifs using an application. This training is expected to introduce an effective device to improve batik production quality and quantity, and therefore, batik SMEs in this region can compete in local and international markets. The Expert Staff for Economics, Finance, and Development also stated his high expectations of Symatrig application use in supporting the batik industry development in the area. He asserted that the regional government strongly supports using digital technologies to enhance SME competitiveness, particularly in the batik sector. In his speech, he hoped that this training could be an initial step in creating batik with modern and diverse motifs and improving the productivity of business owners. It is believed to positively increase the local economy and strengthen batik's image as a featured product of Paluta Regency.

Training and coaching were attended by 30 batik makers across regions in Paluta Regency. The activity began by installing the Symatrig application on participants' devices and then distributing the guidebook. Then, the source person introduced the application screen and explained the functions of menus and buttons in Symatrig by demonstration. Alongside, students assisted the participants in developing new motifs using Symatrig features. The training ran smoothly, and the participants enthusiastically tried various features to generate creative batik designs. The participants were active in asking questions and experimenting. It thus created an interactive and productive training atmosphere. At the end of the activity, a representative of the participants expressed gratitude for the knowledge and application provided. They were optimistic that Symatrig would help them to develop innovative batik motifs. With a better understanding of application features, the participants hoped to implement Symatrig in the batik designing process to create fascinating and competitive works.

Figure 7. Documentation of the activity

Evaluation

After finishing the training and coaching activity, the team distributed a satisfactory questionnaire consisting of 15 questions to the participants. The questionnaire was designed to evaluate the participants' satisfaction level using the Symatrig application. The questions covered various aspects, such as the ease of application operation, the benefits of available features, and whether the application can help participants develop their batik motifs more efficiently and creatively. The questionnaire aims to receive in-depth participant feedback regarding the Symatrig application's effectiveness in supporting the batik designing process. Collecting responses on users' experiences will inform the team to understand whether the application fulfills participants' expectations and the areas to be improved to maximize the benefits. This evaluation is vital in follow-up development and application perfection to be optimized for use by batik makers. The list of questions and answers is displayed in Table 1.

Of 30 participants attending the training program on Symatrig application use, none were very dissatisfied nor dissatisfied with the training or the application. The results show that the overall participants were satisfied with two critical aspects of the activity: training and Symatrig application quality.

The training ran smoothly and successfully delivered new knowledge and skills to the participants. Zero complaints of dissatisfaction show that the training method was effective, from the material delivery by the source person, clear guidebook, and direct coaching by the team. The participants were enthusiastic during the training and highly involved in understanding and applying Symatrig application features.

Furthermore, Symatrig also received a positive response from the participants. Most believed the application was easy to use, facilitating the development of batik motifs and accelerating the design process. The application's success in fulfilling the participants' expectations is reflected in the absence of significant negative responses toward the application's use or performance. In other words, Symatrig can provide a satisfactory experience for users, following the objective of improving the creativity and productivity of batik industry owners.

Table 1. Satisfactory questionnaire of Symatrig users

Indicator	Evaluation				
	VD	D	N	S	VS
I get new knowledge from the training held	0	0	0	12	18
Training on using the Symatrig application is beneficial for me	0	0	0	15	15
The source person explains the material clearly	0	0	2	13	15
I can follow the training well	0	0	0	15	15
The training held is structured	0	0	0	13	17
The instructor is prompt in helping me understand the Symatrig application	0	0	0	20	10
I feel that similar training with other applications needs to be held again	0	0	0	11	19
The Symatrig application display is attractive	0	0	2	20	8
The Symatrig application display is easy to understand	0	0	0	18	12
It does not take long for me to learn the Symatrig application	0	0	5	18	7
I can easily run the Symatrig application	0	0	3	19	8
The Symatrig application buttons work as they should	0	0	2	18	10
I will use the Symatrig application in my batik business	0	0	0	13	17
I am optimistic that the Symatrig application can help me in developing batik motifs	0	0	0	10	20
The guidebook provided makes it easier for me to understand how to use the Symatrig application	0	0	0	14	16

Note: VD = Very Dissatisfied, D = Dissatisfied, N = Neutral, S = Satisfied, VS = Very Satisfied

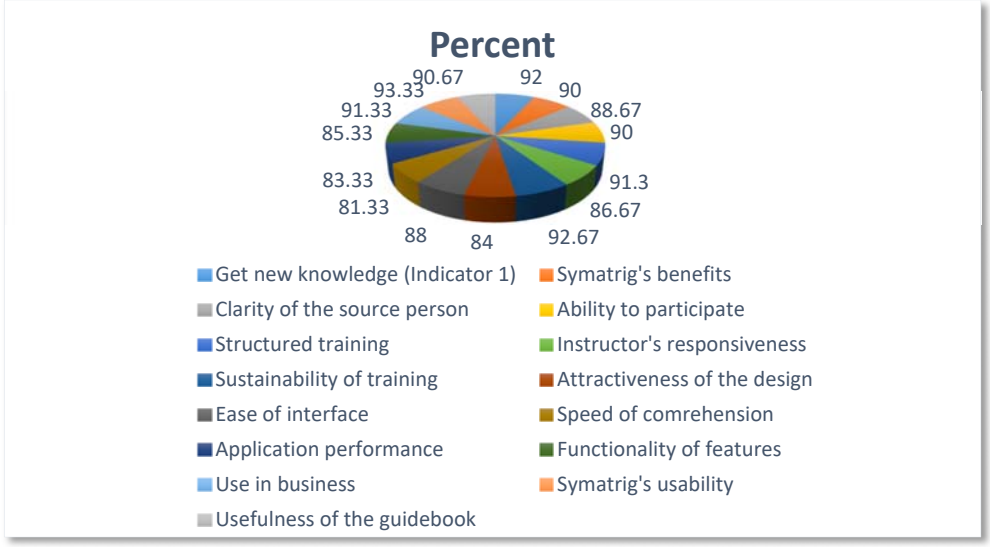

Figure 8. Satisfaction percentage of Symatrig users

Overall, the results reflect the success of training and Symatrig application in fulfilling participants' needs. Participant satisfaction is an essential indicator that the training and application can continuously

develop and benefit the future of batik SMEs. Figure 8 shows a clear satisfaction level percentage of Symatrig users.

Discussion

The training and coaching for Symatrig application use in developing batik motifs in Paluta Regency is not merely technology use but also a means to enhance the sustainability and innovation of the batik industry, which has high cultural value. From the creative economy development perspective, the application is essential in introducing a technology-based design approach, enabling batik makers to dig deeper into their creative potential (Fachri et al., 2024; Rif'ah & Amin, 2024). In-depth, the Symatrig application functions as a tool that facilitates motif exploration faster and more efficiently by allowing batik makers to visualize various motifs in a digital form before applying them in the real batik media. It reduces the dependence on manual methods that consume time and costs and simultaneously increases productivity without sacrificing quality.

The importance of coaching in this training is also significant. Direct continuous coaching allows batik makers to overcome technical or creative issues they face in using the application and developing batik motifs following the market demand. In this context, coaching acts as a bridge between technical knowledge acquired during training and practical implementation in daily batik production. Through sustainable interactions with competent coaches, batik makers can receive an in-depth understanding concerning the application potentials in designing motifs with commercial values and strategies to implement such motifs in mass production (Kartika et al., 2023).

Moreover, the digitalization process of batik designing conducted through the Symatrig application empowers batik makers to explore new motifs by maintaining traditional elements that become the local identity. In this matter, digital technologies facilitate the design process and drive batik makers to think freely and experiment with numerous shapes, colors, and motif compositions (Sinaga & Kartika, 2023; Wibawanto et al., 2020; Wibawanto & Nugrahani, 2018). It triggers innovations in batik designs that improve batik product competitiveness from Paluta Regency in the global market. Batik motif innovations based on local traditions are expected to serve a particular appeal for consumers, domestic and international.

From the economic perspective, Symatric application use potentially directs batik makers to utilize technologies as an instrument to accelerate production time and improve product quality. In a creative industry such as batik, the speed in creating intriguing designs that follow market trends is a vital factor in winning the competition (Ferdiansyah & Abadi, 2023). Symatrig allows batik makers to experiment with more designs in a shorter time and facilitates the modification process of existing designs. Efficiency created by this application can reduce production costs usually related to manual or conventional motif printing. Therefore, the results are not limited to design quality but also the profit increase for batik makers.

The diversity in motifs generated from this application is hoped to develop the batik market in Paluta Regency by reaching more extensive and diverse consumer segments. Batik design innovations enrich consumers' selections and increase the selling value of batik products (Karimah et al., 2024; Sasmita et al., 2024). Nowadays, consumers search for unique products with high aesthetic value that reflect a strong cultural identity. With the Symatrig application, batik makers can produce designs that highlight traditional values and adapt to developing market preferences, particularly in youths and the global market, which prioritizes innovation and diversity aspects.

Overall, training and coaching of Symatrig application use have broad implications for batik industry sustainability in Paluta Regency. With terrific digital skills and batik design innovations, batik

makers are expected to improve their product competitiveness in local and international markets. Furthermore, it potentially contributes significantly to the regional economy by opening new market opportunities and increasing community income depending on the batik industry. This approach can be a model for creative industry development in other regions that wish to combine technologies and traditions to create competitive products with added value.

4. CONCLUSION AND RECOMMENDATIONS

The training and coaching activity of the Symatrig application to develop batik motifs, as a collaboration between Universitas Negeri Medan and the Department of Industry and Trade of Paluta Regency, has successfully achieved its objectives. This training provided participants with technical skills to effectively use the application to create innovative and efficient batik motifs while gaining an in-depth understanding of the application's potential to enhance productivity and competitiveness in the local batik creative industry. Throughout the training, participants demonstrated high enthusiasm and actively engaged in each session, both during the introduction of the application features and the hands-on coaching. The Symatrig application has proven effective in facilitating the batik motif design process with its various features, allowing participants to create freely and efficiently. No participants expressed dissatisfaction with the training or the application, indicating that the material presented aligned with their needs, and the application met their expectations in supporting creativity and productivity. Overall, the training positively impacted the participants' ability to develop batik motifs and provided opportunities for batik SME owners in North Padang Lawas Regency to leverage technology to improve product quality and competitiveness. Based on the feedback data, the majority of participants rated the training and the application positively. 92 percent of participants reported gaining new knowledge, and 90 percent acknowledged the benefits of the Symatrig application. Clarity of the source person was rated at 88.67 percent, while the ability to participate was rated at 90 percent. The structured nature of the training received a rating of 91.3 percent, and the responsiveness of the instructor was rated at 86.67 percent. Sustainability of the training scored the highest at 92.67 percent. The design attractiveness was rated at 84 percent, while the ease of the interface was rated at 88 percent. Speed of comprehension was rated at 81.33 percent, and application performance received a score of 83.33 percent. Functionality of features was rated at 85.33 percent, while the usefulness of the application in business scored 91.33 percent. Symatrig's usability was highly rated at 93.33 percent, and the usefulness of the guidebook was rated at 90.67 percent. These positive ratings indicate that the training was successful in meeting participants' expectations and enhancing their ability to apply the technology in their batik businesses.

For further development, it is recommended that the Symatrig application add new features supporting motif development and improve the interface to be more user-friendly. Regular training for batik makers is essential to allow them to use this technology maximally. Moreover, collaboration between academics, the government, and business owners must be strengthened to drive sustainable innovation. Periodic evaluation is also necessary to ensure the achievement of productivity and competitiveness improvement of batik SMEs.

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