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Empowering Batik Bambu Mujur MSMEs with Smart Canting, Production Ergonomics, Digital Management, and Marketing 4.0

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ABSTRACT
Background: Bambu Mujur Batik, an Micro, Small, and Medium Enterprise (MSME) producing hand-drawn batik in Sumbermujur Village, faces challenges in production, management, and marketing.
Purpose of the study: This Community Developemnt Program aim to solve this enterprise problems by introduced appropriate technology tools and participatory training to strengthen technical and managerial capacities.
Methods: Smart canting technology and digital marketing were employed to address production capacity and marketing challenges. In addition, training sessions were conducted to enable participants to effectively use these tools. Training was developed based on participants' needs and evaluated using pre- and post-tests.
Results: Results showed increased knowledge and skills across all modules, with normalized gain values of 0.61–0.84. These improvements enhanced production efficiency, workplace safety, and business digitalization. The outcomes support SDGs 8 and 9, demonstrating that integrating appropriate technologies with participatory training effectively strengthens MSMEs' competencies and competitiveness.

Keywords
Hand-drawn batik;
Micro, Small and Medium Enterprises (MSMEs);
Appropriate Technology;
Participatory Training;
Digitalization

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Introduction

Batik, recognized by UNESCO as an intangible cultural heritage since 2009, plays a vital role in the development of Indonesia's creative economy. The existence of batik micro, small, and medium enterprises (MSMEs) has been proven not only to preserve local culture but also to contribute significantly to employment (Muhammad Tony Nawawi et al., 2019). To support this framework, the Community Development (CD) program from the University of Muhammadiyah Surabaya, which is part of the Smart Canting Team, partnered with Batik Bambu Mujur, an MSME located in Sumbermujur Village, Candipuro District, Lumajang Regency. Founded in 2011 by Nurul Huda, Batik Bambu Mujur has grown into a preserver of hand-drawn batik, involving eight local workers in its production process. The competitive advantage of this MSME lies in its use of sustainable natural dyes including tarum (Indigofera tinctoria) for blue, mahogany (Swietenia mahagoni) for brown, and jolawe (Terminalia bellirica) for dark yellow obtained from the forests surrounding the village, in addition to synthetic dyes (Indrayani et al., 2020). Its distinctive batik motifs, inspired by bamboo, the Mujur River, and Mount Semeru, not only represent local wisdom but also align with the trend of environmentally friendly batik (eco-fashion), which is increasingly in demand by global consumers, in line with the development of eco-fashion batik products in various MSMEs in Indonesia (Rahayu et al., 2020). The strategic position of the Batik Bambu Mujur MSME is also strengthened by the growing tourism potential of Lumajang Regency. Research on the development of Bamboo Forest ecotourism emphasizes the importance of infrastructure, management, promotion, and community participation in the development of natural tourism destinations (Rahayu et al., 2020). In addition to the Bamboo Forest, the area around Sumber Mujur Village is also supported by leading tourist destinations such as Ranu Kumbolo, Watu Pecak, Kertowono Tea Plantation, Ranu Klakah Glamping, and the Senduro area, which further enhances the region's attractiveness (Nisa et al., 2019). This linkage opens up a significant opportunity for Batik Bambu Mujur to innovate through the application of Smart Canting technology as a superior regional product, while strengthening the integration of the creative economy sector with sustainable tourism in Lumajang.

Based on field studies and in-depth interviews with the owner and members of Batik Bambu Mujur, it was discovered that the hand-drawn batik production process at this MSME uses traditional methods with lengthy stages. Complex pattern designs require 7–14 days per design using 2B pencils and pattern paper, with an average productivity of two new designs per month.

Overall, the time required to produce one sheet of traditional natural dye batik cloth (excluding pattern making time) ranges from 32–89 days, while for synthetic batik with complex patterns it is relatively shorter, namely around one month. In addition, the unorganized layout of the production room causes work inefficiencies of up to 30% due to the distance and movement of materials and equipment. The lighting of the production room only relies on 15 watt LED lamps (around 150 lux), there is adequate ventilation in the form of two windows, and raw material storage on three wooden shelves measuring 1.5 m × 0.5 m. With inadequate workplace ergonomic conditions, where workers sit cross-legged without a base or use short plastic chairs or stand, bending which can result in injuries due to incorrect work posture (Agustian, 2022; Paiman et al., 2023).

The current marketing strategy remains highly traditional, dominated by offline sales through production houses, local exhibitions, and agency orders. Online marketing has not been optimally utilized. There is no clear strategy for reaching customers outside the region, nor is there a partnership with souvenir shops, agencies, or batik communities within and outside the region. Product packaging remains uninformative, with products packaged in plain plastic without product labels, ingredient information, or manufacturer contact information. Customer and transaction records are also unstructured, making it difficult for businesses to develop effective marketing strategies. Even though it has been proven that attractive packaging design and the use of online shops can increase batik fabric sales (An'ars et al., 2023; Suranto et al., 2023)

Method

Location and Subject of Activities

This Community Development (CD) activity was held from August to November 2025 at the Batik Bambu Mujur MSME in Sumbermujur Village. The community service participants were eight members of the MSME Batik Bambu Mujur , while the CD implementation team consisted of four lecturers and two students from the Electrical Engineering, Civil Engineering, and Accounting programs.

Activity Implementations

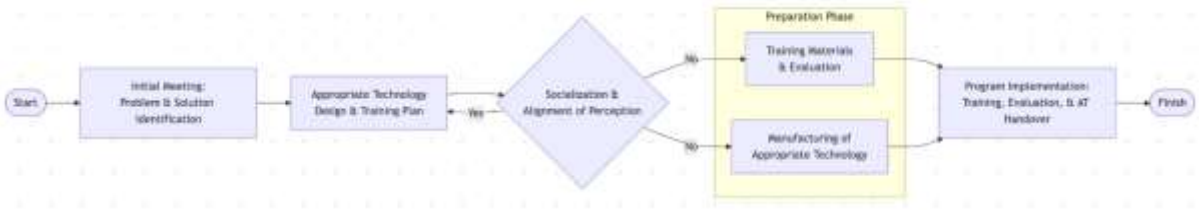


Figure 1. Community Development Flow Diagram

The CD implementation method shown in Figure 1 begins with an initial meeting to identify problems and solutions through a participatory approach (needs assessment) involving partners. This step is crucial for ensuring the relevance of the intervention and determining success indicators (Lee et al., 2016). Next, a pre-test instrument and training module are developed as part of the initial verification and training curriculum design. This development framework includes needs analysis → design of appropriate technology materials and tools (appropriate technologies) → socialization → implementation → evaluation (Kirchner et al., 2022).The next stage is socialization and alignment of perceptions between the implementation team and participants. At this stage, a feedback loop or decision-making mechanism operates: if there is no agreement, the program returns to the instrument and material design refinement phase, so that implementation is not continued without consensus. This iterative approach aims to increase the chances of adoption of the developed appropriate technologies (Hong et al., 2023). If perceptions are aligned, activities enter the preparation phase, which consists of two parallel paths: (1) preparation of training and evaluation materials, and (2) creation of the appropriate technologies. Once preparation is complete, the program is implemented, including providing training materials, practicing the use of the appropriate technologies, formative evaluation, field monitoring, and handing over the appropriate technologies to partners. The final stage is the completion of the program with an evaluation of its results to assess its effectiveness and develop a sustainability plan.

Design of Appropriate Technology Activities and Products

Starting with an initial analysis of the problems faced by Batik Bambu Mujur, the project then conducted outreach through an integrated activity design that included the development of appropriate technology and the development of training materials. Thus, the appropriate technology and training material development processes ran simultaneously, complemented each other, and could be directly implemented in the partner's work environment. The appropriate technologies planned for this CD includes an automatic batik tool (smart canting), an ergonomic batik workstation, display racks for exhibiting batik fabrics, an effective workspace layout design, and a website that supports online shopping, accounting, and raw material inventory recording. To enable the MSME to make effective use of the appropriate technologies, several workshops were conducted, including the use of the smart canting and digital batik motif design, work

productivity related to working posture and efficient workspace arrangement, and the use of the website for online shopping, accounting, raw material management, and packaging design to make the products more attractive.

Workshop Evaluation Instruments

To assess the effectiveness of the workshop program, participants' understanding levels were measured before and after the workshop using pre- and post-test instruments. These instruments were designed to explore the extent to which participants understood the material presented in each training session, including the use of the Smart Canting, a website-based inventory management system, ergonomics, digital content management, and accounting. A complete list of questions used in the pre- and post-tests which served as the basis for measuring the increase in participants' knowledge and skills after the training sessions.

Table 1: *Pre-Post Test Questions*

No	Category	No	Category
1	I understand the benefits of using batik-making technology tools (appropriate technology Smart Canting) in the batik production process.	16	I understand how to display batik products through a website or marketplace.
2	I understand the basic working principles of the Smart Canting tool used in the training.	17	I understand the steps to independently upload product photos and descriptions.
3	I am able to follow the steps for using the Smart Canting tool according to the instructor's guidance.	18	I understand how to update product information to keep it attractive to buyers.
4	I understand how to use digital batik patterns together with the Smart Canting tool.	19	I understand the benefits of using online media to expand batik business networks.
5	I understand that using the Smart Canting tool can help reduce fatigue and speed up the batik-making process.	20	I understand the importance of maintaining the appearance and brand image of the batik business on digital platforms.
6	I understand the function of the website-based inventory management system introduced in the training.	21	I understand how to record simple financial transactions from batik business activities.
7	I understand how to record and update raw material stock through the system.	22	I understand how to use digital bookkeeping applications to record transactions.
8	I am able to view and understand raw material stock reports from the system.	23	I am able to view financial report outputs from the digital bookkeeping system.
9	I understand the benefits of a website-based system in assisting inventory administration tasks.	24	I understand the difference between manual record-keeping and record-keeping using applications.
10	I understand how to use this system to monitor material requirements more accurately.	25	I understand the benefits of digital bookkeeping systems in supporting business financial records.
11	I understand the meaning and benefits of applying ergonomics in batik-making activities.	26	I understand the function of packaging in increasing the attractiveness of batik products.

No	Category	No	Category
12	I am able to identify non-ergonomic body postures while working.	27	I understand the important elements of packaging design (color, shape, and material).
13	I understand how to improve sitting or standing posture to be more comfortable and healthier.	28	I understand how to create or update packaging designs to match product identity.
14	I understand how to adjust the height of an ergonomic batik table according to my working posture.	29	I understand the influence of packaging design on customer purchase intention.
15	I understand that the application of ergonomics can help improve work comfort and productivity.	30	I understand how to choose packaging materials that are safe, attractive, and suitable for batik products.

Then, to measure the increase in participants' understanding of the workshop material, a pre-test and post-test method was used with a Likert scale of 1–5, where a value of 1 indicates a very low level of understanding and 5 indicates a very high level of understanding.

Data Analysis

The pre- and post-test data were then analyzed using the mean score and gain score calculations to determine the extent to which participants' understanding had improved after the training (Patni et al., 2019). The average score calculation was used to determine the level of participants' understanding of each topic before and after the workshop, as in equation 1:

$$\bar{X}_{\text{pre}} = \frac{1}{n}\sum_{i=1}^{n} X_{i,\,\text{pre}} \,, \bar{X}_{\text{post}} = \frac{1}{n}\sum_{i=1}^{n} X_{i,\,\text{post}} \tag{1}$$

where the value of $\bar{X}_{\text{pre}}$ represents the participant's baseline level of understanding before receiving workshop, while $\bar{X}_{\text{post}}$ represents the level of understanding after workshop, n is the number of respondents, $\bar{X}_{\text{pre}}$ and $\bar{X}_{\text{post}}$ are participant i's scores on the pre-test and post-test, respectively.

Gain score is a measure used to determine the extent of increase in knowledge or understanding achieved by participants after participating in an intervention (e.g.,workshop), in other words, it measures the impact of training quantitatively (Adawiah et al., 2023). By substituting equation 1, the gain score is obtained as in equation 2:

$$\text{g} = \bar{X}_{post} - \bar{X}_{pre} \,, \qquad \text{G} = \frac{\bar{X}_{\text{post}} - \bar{X}_{\text{pre}}}{X_{max} - \bar{X}_{\text{pre}}} \tag{2}$$

where the g value represents the general gain score, G represents the normalized gain (is a statistical measure ($0 \leq G \leq 1$) used to assess the effectiveness of a training in improving participant understanding rather than g), X_{max} is the maximum score (e.g. 5 for a Likert scale of 1–5). Table 2 can be used to measure the interpretation value of the effectiveness of a training.

Table 2: Interpretation of Normalized Gain Values

Value Range G	Interpretation of Effectiveness
$G < 0.3$	Low small increase in understanding
$0.3 \leq G < 0.7$	Medium moderate increase in understanding
$G \geq 0.7$	High significant increase in understanding

Result

Community Development Socialization

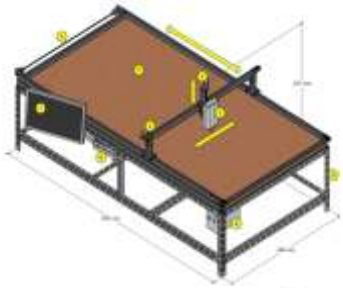
The Smart Canting Team conducted outreach on proposed batik production tools and training for Batik Bambu Mujur's MSME partners. The activity included theoretical explanations, demonstrations on how to use the table and smart canting, and interactive discussions to address production challenges experienced by partners (Figure 2).

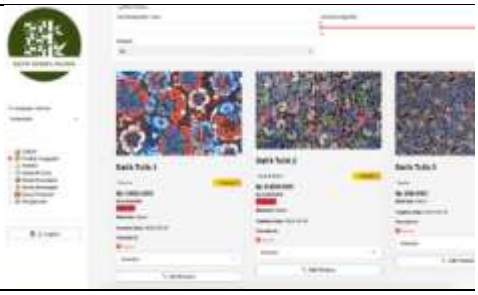
Figure 2. Socialization Program to Batik Bambu Mujur as a partner

Appropriate Technologies Implementation

The CD team successfully implemented several appropriate technologies tools tailored to the needs of MSME partners. Based on Table 3, the appropriate technologies that have been produced and implemented include Smart Canting, Batik Display Workshop, and Ergonomic Workstation, each of which functions to simplify the batik process, increase work comfort, and support product arrangement and presentation. In addition, supporting appropriate technologies in the form of Layout, Inventory System, Financial Management, and Digital Gallery & Online Marketing have also been implemented to improve production management, inventory management, financial recording, and digital marketing of MSMEs.

Table 3: The Appropriate Technologies Produced

Name of Appropriate Technologies	***Design***	***The Produced Appropriate Technologies***
Smart Canting		
Workshop Display Batik		
Ergonomic Workstation		
Lay Out		
Inventory System and Financial Management	-	

Name of Appropriate Technologies	***Design***	***The Produced Appropriate Technologies***
Digital Gallery & Online Marketing	-	

After the smart canting training and handover process, the MSME utilized the equipment in batik production, particularly for the *japlak* stage. The *japlak* refers to the process of transferring batik patterns from paper onto fabric. Traditionally, this process is performed manually by artisans and typically requires 3–5 days to complete. By using the smart canting machine, the *japlak* process requires 2.5 hours, with an additional 1.5 hours for preparation and cooling, resulting in a total production time of 4 hours per fabric. The batik fabric produced using the smart canting is shown in Figure 3. During the adjustment of canting temperature, line thickness, and batik pattern shapes, continuous communication was maintained between the project team and the MSME owner to ensure that the production results were consistent with traditional batik standards.

Similarly, the use of an online gallery and marketplace platforms has expanded the sales reach from previously offline transactions limited to a single district to broader regional accessibility. However, the MSME still requires further adaptation to digital marketing systems.

An ergonomic workspace arrangement improves work efficiency by enabling more organized placement of tools and materials. As a result, workers can locate required items more quickly. For example, unnecessary searching movements for materials can be eliminated from the work system, thereby increasing production time efficiency.

Prior to the empowerment program, the MSME operated with an informal and centralized management system, where most decisions were made by the owner without clear role distribution. After the program, the enterprise adopted a more structured management arrangement, including defined roles for production, finance, and marketing. This structural change has improved coordination, accountability, and decision-making efficiency. As an outcome, the MSME demonstrates increased managerial capacity, reflected in faster operational decisions, better production planning, and improved responsiveness to market demand.

Figure 3. The batik-making process for the Batik Bambu Mujur pattern using Smart Canting.

Workshop Activities

Community Development team workshop activities are presented in Table 4. The most important workshop is the smart canting workshop that aim to increase the productivity of the batik. The Smart Canting operational training was attended by prospective equipment operators from the Community Development partner institution. This training focused on technical and operational aspects, including a detailed explanation and hands-on practice of the standard operating procedures (SOPs) for Smart Canting usage. The materials covered device initialization and shutdown procedures, safety considerations during operation, and operational parameter settings. In addition, participants were trained to prepare digital batik patterns using CorelDRAW, including file setup, pattern adjustment, and design conversion to g-code using inkspace, so that the digital designs could be accurately transferred and applied onto fabric during the batik-making process as shown in Figure 3.

As an outcome of the training, participants demonstrated an improved understanding of Smart Canting operations and were able to independently operate the equipment in accordance with established SOPs. Furthermore, participants gained the capability to create and prepare digital batik designs and successfully implement them in the production process, thereby supporting increased production efficiency and consistency of batik patterns.

Table 4: Workshop Activities

Workshop and Descriptions	Documentations
Work productivity and ergonomics workshop related to work posture. The work productivity and ergonomics workshop related to work posture, led by Yessie Ardina Kusuma, S.T., M.T., emphasized the importance of ergonomic work posture to reduce the risk of injury and increase production efficiency. The session included practical exercises using developed ergonomic desks and work equipment.	
Basic accounting and use of digital accounting systems. Basic Accounting and Digital Accounting System Application Training, delivered by Gita Desipradani, S.Pd., M.M., MSA. The presenter provided simulations of transaction recording, business financial management, and the use of digital accounting software so partners can monitor cash flow and financial reports more accurately and efficiently	
Website-based raw material inventory management system The third training covers Website-Based Raw Material Inventory Management System, Website and Marketplace Content Management, Business Network Development, and Product Packaging Design to Improve Product Quality and Attractiveness, guided by Dr. Indah Kurniawati, S.T., M.T. This activity combines	

Workshop and Descriptions	Documentations
inventory digitalization practices, online marketing optimization, and attractive packaging design, so that partners can significantly improve production management and product sales value.	
Workshop on Smart Canting Operation This Smart Canting operational training was attended by prospective operators from the CD partner. The training covered the standard operating procedures (SOPs) for using the equipment, including how to turn the device on and off, as well as how to prepare digital batik designs using CorelDRAW so that they can be applied to fabric.	

Workshop Evaluation Results

The workshop evaluation results show a significant increase in participants' understanding and skills across all modules presented in Table 5. In the Smart Canting Technology (A) workshop, the average Post-Test score reached 4–4.5, indicating that participants' understanding of smart canting technology increased evenly. The Inventory System (B) workshop showed an increase from 1.2–1.8 in the Pre-Test to 3.6–4.5 in the Post-Test, indicating better mastery of the digital-based inventory management system. In the Ergonomic Workstation (C), the Post-Test score reached 3.8–4.7, indicating that participants were able to understand and apply ergonomic concepts to work desks and equipment. The Digital Marketing (D) workshop showed an increase from 1.0–2.0 to 3.5–4.5, indicating an increase in understanding of digital marketing strategies and online content management. For Financial Management (E), the Post-Test score increased from 1.4–2.0 to 3.5–4.6, indicating participants' ability to record finances and manage their business more effectively. Finally, the Packaging Design (F) workshop showed an increase from 1.2–2.0 in the Pre-Test to 3.5–4.5 in the Post-Test, indicating that the participants' ability to design attractive product packaging and improve product quality is growing.

Table 5: The workshop evaluation results

Module	Workshop Topic	Pre-Test Score Range	Post-Test Score Range	Evaluation Outcome
A	Smart Canting Technology	–	4.0 – 4.5	Participants' understanding of smart canting technology increased evenly, indicating strong mastery of the material.
B	Inventory System	1.2 – 1.8	3.6 – 4.5	Significant improvement in participants' mastery of the digital-based inventory management system.
C	Ergonomic Workstation	–	3.8 – 4.7	Participants were able to understand and apply ergonomic concepts to work desks and equipment.
D	Digital Marketing	1.0 – 2.0	3.5 – 4.5	Increased understanding of digital marketing strategies and online content management.
E	Financial Management	1.4 – 2.0	3.5 – 4.6	Improved ability to record financial transactions and manage business finances

Module	Workshop Topic	Pre-Test Score Range	Post-Test Score Range	Evaluation Outcome
				effectively.
F	Packaging Design	1.2 – 2.0	3.5 – 4.5	Participants' skills in designing attractive packaging and enhancing product quality increased.

Based on Table 6, the normalized gain results indicate that all participants demonstrated a substantial improvement in their understanding across all training modules. The overall average gain ranged from 0.61 to 0.84, with Participant 8 exhibiting the highest gain (0.84) and Participant 1 exhibiting the lowest (0.61). Specifically, the Smart Canting module yielded gains between 0.57 and 0.85; the Inventory System module between 0.57 and 0.83; the Ergonomic Workstation module between 0.58 and 0.88; the Digital Marketing module between 0.55 and 0.82; the Financial Management module between 0.58 and 0.87; and the Packaging Design module between 0.60 and 0.88.

Table 6. Normalized Gain of Participants in Each Training Module

Participant	Smart Canting	Inventory System	Ergonomic Workstation	Digital Marketing	Financial Management	Packaging Design	Overall Gain
1	0.57	0.60	0.68	0.60	0.62	0.60	0.61
2	0.58	0.63	0.58	0.62	0.65	0.67	0.62
3	0.70	0.62	0.65	0.55	0.67	0.63	0.64
4	0.73	0.73	0.75	0.82	0.82	0.88	0.79
5	0.72	0.75	0.783	0.80	0.80	0.78	0.77
6	0.65	0.57	0.63	0.62	0.58	0.68	0.62
7	0.73	0.62	0.70	0.58	0.67	0.70	0.67
8	0.85	0.83	0.88	0.82	0.87	0.80	0.84

Discussion

Workshop Effectiveness Analysis

The training evaluation results showed that the implementation of Appropriate Technology and participatory training modules successfully improved participants' understanding and skills across all training categories. These results confirm that the implementation of appropriate technologies aligned with the production needs and working conditions of partners can accelerate improvements in technical competence and productivity(Adinugraha, 2021; Purnomo et al., 2022).

Analysis of the Inventory System, Digital Marketing, and Financial Management modules also showed significant improvements, although they tended to vary among participants, as shown in Table 6. Nevertheless, all participants recorded an overall gain of more than 0.6, which, according to Table 3, indicates training effectiveness in the "moderate" to "high" category. This finding confirms that the training not only improves technical skills but also facilitates the readiness of MSME partners to adopt more modern business management and digital marketing practices (Idah & Pinilih, 2020; Murtiningsih & Caroline, 2024).

The consistent increase in participants' understanding aligns with the iterative CD approach, which includes needs assessment, module development, socialization, and simultaneous appropriate technologies implementation. This participatory method ensures that training

materials and tools match MSME needs, working conditions, participant skill levels, and the manual nature of traditional batik production. This was evident in the Smart Canting training, where direct practice on complex motifs made knowledge transfer more concrete and adoptable.

In addition, the integrated design of the appropriate technologies and training modules improved production efficiency and work management. The use of ergonomic workstations, effective layouts, and a web-based inventory system helped participants understand how posture, workspace organization, and productivity are interconnected an essential improvement given previous infrastructure limitations and traditional, time-consuming practices that carried injury risks (Akip, 2024; Ayun & Rini Rahayu, 2022).

The effectiveness of the training was reinforced by its alignment with market opportunities and global trends such as eco-fashion and digital marketing. Improved participant understanding of digital marketing, financial management, and packaging design enabled Batik Bambu Mujur to expand its business network, increase product value, and strengthen a sustainable local creative industry. This supports SDGs 8 and 9 and aligns with the Asta Cita creative industry mission, showing that the training enhances not only technical abilities but also overall business competitiveness (Susanti & Santoso, 2021). At the conclusion of the CD activity, the appropriate technologies equipment handover was shown in Figure 5.

Figure 5. Handover of Appropriate Technology to the Batik Bambu Mujur

Program Sustainability and Follow-up Plan

The sustainability of the Batik Bambu Mujur program is focused on post-training monitoring and mentoring so that the appropriate technologies that has been submitted is truly utilized optimally in the production, management, and marketing processes (Pratama et al., 2022; Nofirza, 2017). The effectiveness of the training was reinforced by its alignment with market opportunities and global trends such as eco-fashion and digital marketing. This supports SDGs 8 and 9 and aligns with the Asta Cita creative industry mission, showing that the training enhances not only technical abilities but also overall business competitiveness.

Conclusion

The implementation of Appropriate Technology and participatory training modules at Batik Bambu Mujur successfully enhanced participants' technical, managerial, and marketing competencies. Normalized gain values indicated substantial improvement across all modules, demonstrating the adoption of improved work practices. The iterative CD approach allowed training materials and tools to be adjusted to participants' conditions and skills. Ergonomic workstations, effective layouts, and digital management systems improved production efficiency, safety, and business processes. Moreover, digital marketing, financial management, and packaging design training strengthened business growth by expanding networks and increasing product value.

These outcomes support SDGs 8 and 9 and align with the Asta Cita mission, demonstrating strengthened individual capabilities and overall MSME competitiveness.

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Conflicts of Interest

The authors declare no conflict of interest.

References

Adawiah, S. A., Gandana, G. G., & Rahman, T. (2023). Media flip book digital untuk mengembangkan kemampuan bahasa anak usia dini. *JECIE (Journal of Early Childhood and Inclusive Education)*, *7*(1). https://doi.org/10.31537/jecie.v7i1.1255

Adinugraha, H. H. (2021). Marketing endorsement strategy in batik kampus: Islamic business ethics perspective. *Scientia: Jurnal Hasil Penelitian*, *6*(1). https://doi.org/10.32923/sci.v6i1.1691

Agustian, F. W. (2022). Analisis daya saing industri pariwisata pada Kabupaten Lumajang dan peningkatan ekonomi daerah. *Jurnal Ilmu Ekonomi JIE*, *6*(4). https://doi.org/10.22219/jie.v6i4.23003

Akip, S. (2024). Customer relationship management pada pengelolaan data transaksi produk usaha mikro kecil dan menegah (UMKM). *PROSISKO: Jurnal Pengembangan Riset dan Observasi Sistem Komputer*, *10*(2). https://doi.org/10.30656/prosisko.v10i2.8037

An'ars, M. G., Hendrastuty, N., Damayanti, D., & Putra, A. D. (2023). Perancangan teks promosi UMKM Sikop Arrum Batik menggunakan program berbasis AI ChatGPT. *Jurnal Pengabdian Kepada Masyarakat (JCD) TABIKPUN*, *4*(1). https://doi.org/10.23960/jCDt.v4i1.109

Ayun, M., & Rahayu, S. R. (2022). Pendampingan teknologi tepat guna UMKM mamin untuk peningkatan kuantitas produksi di Desa Minggirsari Kecamatan Kanigoro Kabupaten Blitar. *Jurnal Pengabdian Nasional*, *2*(April).

Hanggraito, A. A., Wiratama, A. S., & Saifuddien, R. A. (2020). Alternatif strategi bauran pemasaran 7P Museum Batik Yogyakarta. *Jurnal Kepariwisataan: Destinasi, Hospitalitas dan Perjalanan*, *4*(2). https://doi.org/10.34013/jk.v4i2.50

Hong, J., Cha, J., Bilegjargal, G., & Park, K. (2023). Evaluation framework for facilitating the technology transfers of universities: Focusing on the perspective of technology donors. *PLoS ONE*, *18*(12), Article e0293951. https://doi.org/10.1371/journal.pone.0293951

Idah, Y. M., & Pinilih, M. (2020). Strategi pengembangan digitalisasi UMKM. *Prosiding Seminar Nasional dan Call for Papers "Pengembangan Sumber Daya Pedesaan dan Kearifan Lokal Berkelanjutan IX"*, *9*(1).

Indrayani, L., Triwiswara, M., Andriyati, W., & Nuraini, E. (2020). Peningkatan kualitas batik eco-fashion dengan pewarna alami jalawe (*Terminalia bellirica*) menggunakan iradiasi berkas elektron. *Jurnal Ilmiah Aplikasi Isotop dan Radiasi*, *16*(2).

Kirchner, J. E., Dollar, K. M., Smith, J. L., Pitcock, J. A., Curtis, N. D., Morris, K. K., Fletcher, T. L., & Topor, D. R. (2022). Development and preliminary evaluation of an implementation

facilitation training program. *Implementation Research and Practice*, *3*. https://doi.org/10.1177/26334895221087475

Lee, S. J., Hoffman, G., & Harris, D. (2016). Community-Based Participatory Research (CBPR) needs assessment of parenting support programs for fathers. *Children and Youth Services Review*, *66*, 184–192. https://doi.org/10.1016/j.childyouth.2016.05.004

Murtiningsih, D., & Caroline, R. T. M. (2024). Digitalisasi UMKM. *Jurnal Kreativitas Pengabdian Kepada Masyarakat (PKM)*, *7*(3). https://doi.org/10.33024/jkpm.v7i3.13861

Nawawi, M. T., Wiryawan, Z., & Dhiah, R. (2019). Management implementation of batik SME strategy in JAMBI. *Journal of Business and Social Review in Emerging Economies*, *5*(2), 263–270. https://doi.org/10.26710/jbsee.v5i2.816

Nisa, N., Widodo, J., & Djaja, S. (2019). Partisipasi Gucialit Organisasi Wisata Alam (Gowa) dalam pengembangan agrowisata kebun teh Kertowono di Kecamatan Gucialit Kabupaten Lumajang. *Jurnal Pendidikan Ekonomi: Jurnal Ilmiah Ilmu Pendidikan, Ilmu Ekonomi dan Ilmu Sosial*, *13*(1), 1–6. https://doi.org/10.19184/jpe.v13i1.10433

Nofirza, N. (2017). Perancangan ulang stasiun kerja pemotongan bokar menggunakan pendekatan ergonomi. *Jurnal Teknik Industri: Jurnal Hasil Penelitian dan Karya Ilmiah dalam Bidang Teknik Industri*, *3*(2), 126–134. https://doi.org/10.24014/jti.v3i2.6431

Paiman, P., Agustin, H. P., & Firdaus, M. (2023). Implementation of the Glagaharum Senduro Lumajang campground tourism marketing strategy, East Java. *Proceeding International Conference on Economics, Business and Information Technology (ICEBIT)*, *4*, 215–224. https://doi.org/10.31967/prmandala.v4i0.840

Patni, L. D. P., Parwati, N. N., & Suharta, I. G. P. (2019). Peningkatan pemahaman konsep matematika siswa melalui penerapan model pembelajaran AIR disertai penilaian portofolio. *Jurnal Pendidikan dan Pembelajaran Matematika Indonesia*, *7*(1). https://doi.org/10.23887/jppm.v7i1.2810

Pratama, G., Tamzil, F., & Elistia, E. (2022). Pemanfaatan strategi pemasaran 5.0 untuk peningkatan penjualan pada kelompok tani Desa Cidokom. *Jurnal Komunitas: Jurnal Pengabdian Kepada Masyarakat*, *4*(2), 140–147. https://doi.org/10.31334/jks.v4i2.2112

Purnomo, B., Siregar, I., Syahputra, M. A. D., & Sahputra, E. (2022). Empowering Jambi batik craftsmen by optimizing marketing through digital applications in Ulu Gedong Village. *International Journal of Education and Social Science Research*, *5*(1), 220–227. https://doi.org/10.37500/ijessr.2022.5130

Rahayu, M. L. S., Riyanto, W. H., & Syaifullah, Y. (2020). Strategi pengembangan ekowisata di Hutan Bambu Kabupaten Lumajang. *Jurnal Ilmu Ekonomi JIE*, *4*(1). https://doi.org/10.22219/jie.v4i1.9564

Suranto, S., Pratiwi, R., Nurgiyatna, N., Pratiwi, A., & Rahman, R. A. (2023). Model pemasaran batik berbasis digital industri kreatif di Indonesia. *AKSES: Jurnal Ekonomi dan Bisnis*, *18*(1). https://doi.org/10.31942/akses.v18i1.8592

Susanti, N., & Santoso, J. (2021). Meningkatkan kinerja produksi dan pemasaran dengan teknologi tepat guna meja pewarnaan dan pemasaran online pada Tia Batik Tanjung Bumi Bangkalan. *Talenta Conference Series: Local Wisdom, Social, and Arts (LWSA)*, *4*(1).

Sutono, S. B. (2022). Perancangan stasiun kerja proses canting berdasarkan pendekatan ergonomi. *Jurnal Teknik Industri: Jurnal Hasil Penelitian dan Karya Ilmiah dalam Bidang Teknik Industri*, *8*(1), 63–70. https://doi.org/10.24014/jti.v8i1.16833