

Enhancing Eco-Print Product Quality Through Women's Creative Empowerment: A Community-Based Approach In Gunungpati, Semarang

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Abstract

Female artisans who are members of the Family Welfare Program (PKK) in Gunungpati, Semarang City, face issues with unstable eco-print quality, particularly in areas of colorfastness, pattern clarity, and neatness of finishing, which makes their products less competitive. The goal of this community service activity is to enhance the quality of eco-print products while empowering women's creativity through training and mentoring using a participatory approach. This activity was conducted for 25 PKK participants through training in basic and advanced eco-printing techniques, hands-on practice, production assistance, and evaluation of the activity results. Evaluation was conducted using a product quality rubric and a simple questionnaire before and after the program. The results of the activity showed an increase in product quality, characterized by more stable colors, clearer patterns, and neater finishing. In addition, the participants experienced increased skills, confidence in their work, and the ability to work in groups. This activity also stimulated the idea of marketing eco-print products as a source of additional income. This program has proven that participatory training and mentoring are effective ways to improve the quality of environmentally friendly products and strengthen the creative economic capacity of women at the community level.

Keywords: Community Service, Eco-Print, Environmentally Friendly Products, PKK, Women'S Empowerment

1. INTRODUCTION

Increased interest in practices such as eco-printing emerged from the global focus on responsible consumption and production in eco-friendly textiles. Eco-printing is part of the green creative economy and environmentally conscious craftsmanship. It also presents economic opportunities to women artisans in developing economies (Chanu et al., 2025, Šabarić et al., 2024, Simi, 2024). There is an increasing expectation that the fashion and craft sectors incorporate social inclusion and sustainability into their production processes, in harmony with the SDGs, especially those targeting economic development and gender equality (Hendriyana et al., 2024, Reza-Gharehbagh & Pullman, 2025). In Indonesia, community women's groups such as Pemberdayaan Kesejahteraan Keluarga (PKK) creatively foster grassroots-level entrepreneurial development. Although these community-based eco-print producers are enthusiastic and have easy access to natural dyes, many still face serious challenges in achieving consistent product quality and competitiveness in the marketplace. This scenario underscores the importance of establishing capacity-building measures, not only designed to strengthen the technical competencies of women within the sustainable fashion industry but also to expand their construction of ingenuity, creativity, and collaborative empowerment amongst peers (Brogan & Dooley, 2023, Farroñán et al., 2024, Suarez-Visbal et al., 2024).

Though eco-print crafts have become more popular with women's community groups, the quality of the output is inconsistent and does not meet market standards. The artisans do not fully grasp the techniques of natural dyeing, design composition, and product finishing, leading to pieces with little durability, poor color fastness, and a lack of visual appeal (Guzman et al., 2024, Simi, 2024). Furthermore, the eco-printing activities related to community citizenship focus on short-term training courses that address skill transfer rather than community empowerment and innovation (Kusrini et al., 2025, Nurhaida et al., 2024). Such fragmentation results in very little increase in income and product competitiveness and leaves artisans dependent on outside facilitators or temporary projects. In the case of Gunungpati, Semarang, underdeveloped community-based capacity building likely explains why the vast natural resources available—particularly leaves and plant-based dyes—have not been translated into more innovative and

sustainable product development. Moreover, the majority of empowerment initiatives continue to overlook the intersection of the creative economy and entrepreneurship, design thinking, and high-value-adding production (Demarchi, 2023, Saad & Youness, 2024, Thomas et al., 2024). This underscores the need for a more comprehensive and integrated approach to empowerment that works to build the technical and creative skills of women while also improving the quality and market competitiveness of eco-print products.

To address the challenges mentioned in the previous section, this research seeks to improve the eco-print products using a community-driven women's creative empowerment project located in Gunungpati, Semarang. The first goal is to create a participatory empowerment model that incorporates the community group PKK (Pemberdayaan Kesejahteraan Keluarga) members' technical empowerment, inventive, creative, as well as design entrepreneurial skills. It is anticipated that the eco-print products' quality in terms of durability, color, and aesthetics will be improved while, at the same time, enhancing confidence and autonomy in production (Kurnianingsih et al., 2025, Na'am et al., 2024). For this purpose, the research is focused on (1) enhancing women's creativity and technical skills in producing sustainable textiles, (2) designing community-based training programs that foster collaborative creativity and (3) enhancing the economic empowerment of local women by increasing product quality and marketability. This research aims to contribute to the evidence-based models of empowerment directed to creating sustainable livelihoods, focusing on the specific goals of the creative economy on women's empowerment, economic development, and sustainability integration (Farroñán et al., 2024, Sundari et al., 2025, Yadav et al., 2025).

Most prior research into the development of eco-prints and the use of natural dyes focused on either the technology, the environment, or the socio-creative aspects of women's empowerment (Simi, 2024, Singh & Singh, 2025). Locating eco-prints in isolation from the broader context of acquiring entrepreneurial skill for economic resilience and product innovation/craft improvement does women eco-printers a disservice. Research into the creative economy has shown that the impacts of women's empowerment programs remain largely unfulfilled because skill acquisition systems are disconnected from the quality and innovation of production and design in the market (Alexander, 2022, Surti et al., 2024). Community-based models of combined empowerment and research into the creative economy focused on sustainable textiles in developing countries and grassroots groups, such as PKK in Indonesia, are scarce. The result is a wide gap between eco-printers' mastery of the craft and the freedom of market innovation, standardization, and a competitive production cycle. This gap speaks to the need for an integrated focus and approach on creative empowerment, community, and improvement of eco-print on craft quality—a gap in focus in the current literature (Achmad & Wiratmadja, 2025, Friedman et al., 2025, Nurhaida et al., 2024).

This article offers a novel perspective by combining women's creative empowerment within a community framework and the development of eco-print products to merge the technical and socio-economic dimensions of empowerment. Whereas other studies primarily enhanced eco-printing techniques and provided skill training of limited duration, this one offers a set of holistic empowerment guidelines where eco-printing is combined with a framework of creativity, innovation, and sustainability (Lakshana et al., 2024, Na'am et al., 2024). This approach conceptualizes women not only as training beneficiaries but as value-creating partners in sustainable green creative economy value chains. This research incorporates community-design structures of participatory learning and collaborative design to develop sustainable, self-reliant entrepreneurial capabilities, which, in turn, contribute to the quality of products (Chavarria & Villari, 2025, Reza-Gharehbagh & Pullman, 2025). Furthermore, this research enhances the theoretical framing of women's empowerment in sustainable crafts by highlighting creative agency as a pivotal element for achieving environmental and economic resilience. It is suggested that results will help policymakers, educators, and development practitioners, who want to target community-based empowerment to the Sustainable Development Goals (SDG 5) Gender Equality, SDG 8) Decent Work and Economic Growth, SDG 12) Responsible Consumption and Production. (Brahe-Orlandi & Mehlsen, 2024, Lakshana et al., 2024). Having this integrated perspective helps the study to not only address a major gap in research but also provides a prototype to sustainably

and inclusively innovate in the local creative industries, thereby promoting inclusive and sustainable innovation.

The Empowerment and Family Welfare (PKK) groups in the Gunungpati area, Semarang City, consist of women active in household economic activities and local, potential-based craft skills (Bappenas, 2020). Some of the PKK members have already met and attempted the eco-printing technique as an environmentally friendly craft product using leaves and the surrounding natural materials. However, based on the initial observation results and discussions with the PKK board, the eco-print products produced still face various problems regarding the quality and the sustainability of the business. The major problem faced by the partner includes the instability of the color resistance, unclear leaf design, and the unfinished product's quality, which is not tidy and consistent. This situation leads the product to be of no competition in the local market, and thus it is strategized only for incidental events such as local exhibitions or limited orders. Besides, the eco-printing skill of the PKK members is still at the basic level and depends on the outside facilitator's example, lacking the production standard operating procedure (SOP) that can be a common reference. The aspect of marketing is still very much limited, indicated by the absence of product identity, simple packaging, and a lack of understanding concerning craft product marketing strategy.

This limitation was strengthened by the initial mapping results, revealing that the eco-print training received was of a short duration, instant, result-oriented, and had no continuous monitoring accompanying it. Consequently, technical knowledge was not optimally internalized, and the women's creativity had not been developed into an independent production capacity. Meanwhile, Gunungpati possesses natural resource potential in the form of various species of leaves and plants that can be sustainably utilized as eco-print materials.

In line with this, a community service program is needed that will not only deal with the transfer of technical skills but also the creative empowerment of women through a participatory community-based approach. This program is designed in the form of training and mentoring in eco-printing, where the participants will be actively involved in the learning process, practice of production, reflection of results, and quality of products. The intervention will be mainly about the improvement of the technical aspects of the eco-printing, the strengthening of the group work, and the building of self-esteem and independence in production. The objectives of the community service activities are: (1) to improve the quality of eco-print PKK Gunungpati products in terms of color fastness, clarity of motif, and finishing, (2) to improve women's skills and creativity through participatory learning, and (3) to stimulate the initial capacity of eco-print green product-based entrepreneurship. It is hoped that the activity will be the first step towards the sustainable empowerment of women's creative economy at the community level.

2. METHODOLOGY

2.1. Partners and Activity Locations

The partners for this community service activity are the women's group of Family Welfare Movement (PKK) members in Gunungpati Village, Gunungpati District, Semarang City, Central Java Province. This group comprises 25 active members who already possess a basic knowledge of eco-printing techniques but lack consistent production standards and product quality. The activities were conducted at the village meeting hall and the partner's production house, which served as the eco-printing practice location (Kemendikbudristek, 2021).

2.2. Implementation Time

The community service program will be implemented over six months, spanning four main sessions. Each session lasts approximately five hours and is conducted face-to-face using a hands-on approach.

2.3. Activity Implementation Stages

The community service program was implemented through several stages, as follows:

1. **Partner Needs Assessment**
The initial stage involved field observations, focus group discussions, and brief interviews with Family Welfare Movement (PKK) administrators to identify the initial level of eco-printing skills, production constraints, availability of local materials, and business development needs.
2. **Designing Training Materials and Modules**
Based on the assessment results, the community service team developed training materials covering eco-printing techniques based on local natural materials, product quality improvement, and an introduction to simple entrepreneurship.
3. **Eco-Printing Technique Training**
The training focused on hands-on practice, including leaf selection and arrangement, the mordanting process, bundling and steaming techniques, color fixation, and product finishing. Participants were actively involved in each stage of production with intensive guidance from the community service team.
4. **Production Assistance and Product Quality Testing**
In this stage, participants were assisted in producing eco-printed fabrics independently and in groups. The resulting products were evaluated using a product quality rubric that included color fastness, pattern clarity, and neatness of finishing.
5. **Group Capacity Building and Reflection**
The final stage involved a reflective discussion to evaluate the activity process, strengthen group work, and formulate a follow-up plan, including marketing opportunities and the sustainability of eco-print production.

2.4. Evaluation of Program Success and Success Criteria

Multiple data collection methods were employed to enhance reliability and triangulation.

- a. **Observation:** Direct observation was conducted during workshops to document participant engagement, creative behavior, and collaboration dynamics.
- b. **Interviews and Focus Group Discussions (FGDs):** Semi-structured interviews and FGDs were used to gather qualitative insights into participants' experiences, challenges, and perceived empowerment outcomes.
- c. **Product Evaluation:** Eco-print textiles produced by participants were assessed using standardized criteria, including color fastness, pattern definition, and design innovation.
- d. **Questionnaires:** A structured questionnaire was administered before and after the intervention to collect quantitative data on participants' knowledge, skills, and empowerment indicators.

These combined techniques enabled the capture of both process-oriented and outcome-oriented data (Miles, Huberman, & Saldaña, 2020).

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Participant Profile and Initial Conditions of Partners

This community service activity involved 25 female members of the Family Welfare Movement (PKK) from Gunungpati Village, Gunungpati District, Semarang City, who actively participated in the entire eco-print training and mentoring program. Of these, 23 participants completed the initial and final evaluation instruments completely, while 2 participants only participated in the practical activities without completing the full questionnaire. This difference served as the basis for consistent data reporting in the results and evaluation sections.

The participants were housewives with side economic activities, such as home-based culinary businesses, simple crafts, and involvement in village-level Family Welfare Movement (PKK) activities. Most had been introduced to eco-printing through previous short training sessions but had not yet implemented it sustainably as a productive enterprise.

Initial mapping results indicate that: 72% of participants have attended eco-printing training once or more, but it was demonstrative and without further guidance, 28% of participants have never practiced eco-printing independently and only know the basic concepts. Not all participants do not yet have standard operating procedures (SOPs) for eco-printing production. Production is carried out incidentally and is not yet market-oriented.

Initial product quality assessments were conducted through direct observation of eco-printed fabric samples produced by participants and preliminary practice before the training. Assessments were conducted using a quality rubric with three main indicators: colorfastness, pattern clarity, and neatness of finishing.

Table 1. Initial Condition of Partner Eco-Print Product Quality

Quality Indicator Category	Poor Category	Adequate Category	Good Category
Color fastness	65%	35%	0%
Pattern clarity	61%	39%	0%
Finishing neatness	70%	30%	0%

The data in Table 1 shows that the majority of partners' eco-printed products fell into the poor category, particularly in terms of colorfastness and neatness of finishing. Colors tended to fade easily after the first wash, leaf motifs appeared blurry or incompletely printed, and the final fabric was rough and uneven. This was due to participants' limited understanding of mordanting techniques, the color fixation process, and proper finishing steps.

In addition to technical aspects, the initial conditions for participant empowerment were also identified through observation and a simple questionnaire. The results showed that 68% of participants expressed a lack of confidence in producing eco-prints independently. 74% of participants still relied on the facilitator's guidance during practice. Group work was not yet optimally developed and was more individual in nature. From a marketing perspective, eco-print products lacked a clear product identity, packaging, or sales strategy. Products were generally only used for personal consumption or displayed only in internal PKK activities.

These initial conditions serve as the basis for designing community service interventions and serve as benchmarks for evaluating the program's success in subsequent phases. By understanding the specific profiles of participants and the partners' real-world problems, community service activities can be directed in a more targeted and sustainable manner.

3.1.2. Implementation of Participatory-Based Community Service Activities

The community service activities were implemented through a participatory approach that placed the participants as active subjects in the whole process of learning and eco-printing production. The activity was divided into four main sessions over a month, with a combination of short lectures, hands-on practice, group discussions, and joint reflections.

In the first session, the focus was on introducing the program and having a common understanding of the objectives of the activities, as well as the problems faced by the partner. Participants were invited to point out the problems that they had been facing in the eco-print process, such as the color coming off easily, the leaf pattern not being clearly printed, and the finishing being rough. The discussion paved the way for the participants to realize the significance of uplifting the product quality together.

The second session concentrated on the training of the eco-print technique through direct practice. The participants were actively involved in the selection of local leaves, the mordanting process of fabric, the arranging of motifs, the bundling technique, and the steaming process. The learning-by-doing approach allowed the participants to experiment and exchange their experiences. In this session, the role of the service team was more like that of a facilitator, while

the participants were given the opportunity to try out and assess their results. This process of training and co-practice is illustrated in Figure 1.



Figure 1. Participants taking part in the Ecoprint making training

The third session is the production stage mentoring, where the participants are starting the production of the eco-print fabric in groups with very little support from the extension team. At this stage, the participants are encouraged to make technical decisions independently, such as choosing the leaf combinations and steaming time control. The mentoring is done to make sure that the process is done according to the standard quality that has been agreed upon together. Figure 2 shows the production mentoring process and the participants' group work.



Figure 2. Participants in groups practicing making Ecoprints

The fourth session was focused on reflection and evaluation of the results of activities. The participants along with the community service team reviewed the eco-print product that had been produced, discussed its strengths and weaknesses, and identified improvement opportunities. This reflective discussion was also used to strengthen group work and formulate follow-up plans, including marketing opportunities for eco-print products around the area. Documentation of the product results and joint reflection was displayed in Figure 3.



Figure 3. Evaluation and results of participants' Ecoprint products

3.1.3. Improvement in Technical and Creative Skills

Analysis of pre- and post-assessments indicates that all participants gained in both technical and creative competencies needed for eco-print production. Quantitative assessment through the paired-sample t-tests confirmed the lower pre-test eco-printing score of overall skills, $M = 62.4$ ($SD = 8.3$), compared to the post-test score of $M = 84.1$ ($SD = 6.9$) ($p < 0.01$), reflecting a high level of eco-printing skill mastery. There were notable advancements in the mastery of leaf selection, mordant preparation, and the treating, fixing, and associated processes of the fabric. Specific mastery in the techniques of pattern placement and fixation of color was evaluated in the

assessment of 88% of participants at the proficient level. Excellence in both pattern placement and color fixation was recognized in the post-evaluation grading rubric by textile experts.

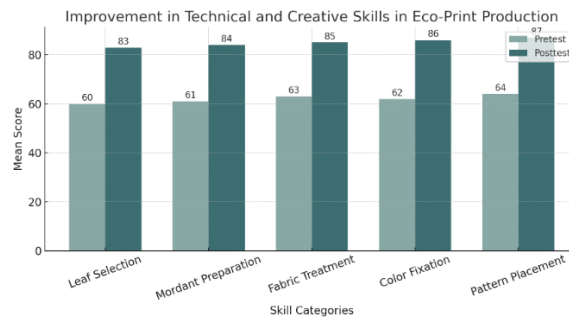


Figure 4. Improvement in Technical and Creative Skills in Eco-Print Production

From a qualitative point of view, the confirmatory data and focus group discussions validated the quantitative results. Respondents showed greater confidence in trying out a variety of local natural materials and in the inventive integration of multiple design layouts, signifying a transition from mere procedural imitation to genuine imaginative inquiry. Several respondents reported enlightenment in that they started to “see leaves not just as materials but as design inspirations,” implying an enhanced aesthetic appreciation and design sensitivity. The mentoring stage more strongly fostered collaborative assistance, where senior affiliates actively helped their peers improve control over their technique and resolve challenges such as color harmony, fabric manipulation.

Moreover, originality was also evident in the expansion of designs and palettes influenced by the region's plants. The provision of more formalized mentoring created opportunities for safe, imaginative risk-taking, whereby individuals, having mastered the techniques, were able to create commercially viable eco-print designs. Overall, these results indicate that the participatory empowerment framework successfully strengthened two of the most critical components for the sustaining innovation and competitiveness of the eco-print craft industry within the community—technical skills and the freedom to create.

3.1.4. Enhancement of Eco-Print Product Quality

The results show very positive improvements in the quality of eco-print products crafted by participants after the empowerment program. Judging by expert evaluations according to a standardized rubric, which includes criteria for color fastness, clarity of the pattern, and quality of the finish, the average quality score before training was $M = 64.7$, $SD = 7.8$, and post-training, the score was $M = 86.3$, $SD = 5.9$ ($p < 0.01$). The fastest improvements by far were in color fastness, where 92% of the participants attained durability scores in the “highly durable” range, indicating that the mordanting and fixation methods taught in the mentoring were successfully applied. The improvements in pattern clarity were equally noticeable. The participants were able to achieve clearer leaf imprints and more symmetry in the motif arrangements by using the more effective material arrangement and pressing methods taught.

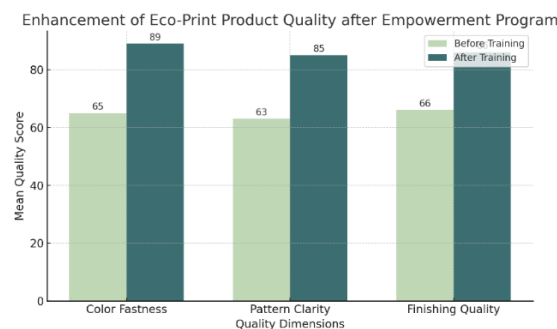


Figure 5. Enhancement of Eco-Print Product Quality after Empowerment Program

The findings were confirmed through qualitative observations as well. Participants exhibited increased care, attention, and detail to their production processes as noted in the field observations. The application of locally attained natural mordents, like alum and lime, mitigated issues of uneven dye penetration to provide finishes that were not only visually appealing but also long-lasting. The experimentations expanded to include layered motifs and color gradations, strengthening the designs' aesthetic coherence and commercial value. One participant stated, "Our prints now look more professional and are easier to sell at local exhibitions." This comment shows the improvement of the product, both in value and in meaning.

Furthermore, the expert evaluators noted how the combination of creative exploration and technical mastery places the participants' eco-print products at a higher market potential than the products made before training. The combination of higher technical mastery and creative exploration offered was a key factor in closing the gap in the quality of products. The noted developments categorically demonstrate the value of community-based participatory training in facilitating the seamless transition of traditional craft skills to new eco-print products, which are environmentally mindful, visually pleasing, and responsive to market demands.

3.1.5 Evaluation of Program Success and Success Criteria

The success of the community service activity was evaluated in a simple and applicable way to assess the program's contribution to the partner's capacity building. The evaluation included assessing the participants' skills in eco-printing before and after the activity, using a product quality rubric to evaluate the quality of the eco-prints produced, and observing the participants' active involvement and group dynamics during the training and support. In addition, a satisfaction and perception survey was conducted among the participants to know their response and experience regarding the executed program. Documented outputs in the form of eco-print products, activity photographs, and a draft of a simple production standard operating procedure (SOP) were also considered as supporting evidence of the program's success.

The community service program was considered successful if it met several main criteria, namely, at least 80% of the participants were categorized as "good" in the quality assessment of the eco-printing products, technical skill improvement, and an increase in the participants' confidence in creativity occurred, producing the eco-print that could be sold in the market. The success of the program was also reflected in the establishment of the participants' group commitment to continuing the eco-print production activity independently as a part of the women's creative economy strengthening project at the community level.

Table 2. Results of Evaluation of the Success of the Community Service Program

No	Evaluation Indicator	Success Target	Achievement Results	Interpretation
1	Participants' eco-print technical skills	Improvement in skills after training	The majority of participants were able to independently perform mordanting, bundling, steaming, and finishing processes	Participants' technical skills improved
2	Eco-print product quality (color, pattern, finishing)	≥80% of participants reach the "good" category	21 out of 25 participants (84%) reached the "good" category based on the product quality rubric	Product quality target achieved
3	Participation and group collaboration	Active and collaborative participation during activities	Participants demonstrated active involvement in hands-on practice and group discussions	Group collaboration was well established
4	Participants' self-	Improvement after mentoring	Participants showed greater confidence in experimenting and expressing design ideas	Women's empowerment increased

5	confidence and creativity Satisfaction and perceived benefits of the program	Participants perceive the program as beneficial	Most participants reported satisfaction and experienced direct benefits from the activities	The program was well-received by the community
6	Program outputs	Availability of products and supporting documents	Eco-print products, activity documentation, and a draft of a simple production SOP were produced	Program outputs were achieved
7	Program sustainability	Commitment to continue production	Participants agreed to form an eco-print production working group	Program sustainability has strong potential

Based on the evaluation results in Table 2, the community service activities demonstrated achievements in accordance with the established success indicators. The majority of participants successfully improved their technical skills and produced eco-printed products of better and more consistent quality. In addition to improving product quality, these activities also impacted women's empowerment, as reflected in increased self-confidence, creativity, and collaborative work abilities. Partner satisfaction and the availability of outputs in the form of products and simple standard operating procedures (SOPs) demonstrate that this community service program is not only technically effective but also relevant to the needs and conditions of partners in the field.

3.2. Discussion

The community-based empowerment model facilitated improvement both in the technical quality of eco-print products as well as in the creative autonomy of Gunungpati women participants. Participatory approaches are testaments to transformative learning and the sustainable building of capacities. This is in line with Freire's (1970) participatory empowerment theory, as the transformative aspect of learning happens when the individual actively collaborates in the knowledge creation process, instead of merely receiving it passively. The participants who received eco-print training had the opportunity to experience 'hands-on' learning, the aspect of learning which is directly aimed at improving one's craft. This process is also important in building one's confidence and in establishing solidarity within the group (Bandura, 2000, Suharto, E., 2014). Furthermore, lending importance to the program's creativity, collaboration, and environmental consciousness resonates with Nussbaum's (2011) capability approach, in which empowerment stems from the expansion of one's intellectual and creative resources, in addition to economically focused empowerment. The innovative use of local plants and construction of market-worthy eco-print products supports Liu et al. (2022) and Hartati et al. (2021), who advocated participatory and context-based learning as a means of sustainable innovation in community-based creative industries. Overall, the findings affirm that empowerment through collaborative practice enhances technical skills and also socio-cultural change by improving women's agency, creativity, and their role in sustainable development.

This community service expands the applicable theoretical frameworks of community-based empowerment by illustrating how participatory learning situated within a local creative industry functions as a socio-economic, pedagogical, and socio-economic strategy for sustainable development. The integration of eco-print production and collaborative experiential learning approaches within the scope of the research illustrates the validity of Kolb's (1984) experiential learning theory, which posits that knowledge is built through doing and reflecting, specifically through a cycle of experience and learning. Training within the socio-cultural environment of the Gunungpati women artisans grounded the research in the practical application of Freire's (1970) critical pedagogy, situating the empowerment process as more than the transfer of knowledge, but the realization of collective agency. This practical application adds to the literature on green vocational education (UNESCO-UNEVOC, 2023) as it shows how situated ecologically creative

frameworks enhance environmental protection. The study also provides for a gender responsive community development and the creative economy, a theoretically anchored, practical approach which highlights its contribution to the empowerment and lived experience of the women artisans. In other words, the research simultaneously advances the participatory learning theory and the integration of approaches for sustainable creative economies in developing contexts.

While the study is commendable for raising the empowerment of women through community-based eco-print activities, I feel it is also important to outline some of the limitations to provide a balanced interpretation of the outcomes. First, the research was undertaken in a single socio-cultural context in Gunungpati, Semarang, perhaps making it difficult to generalize the outcomes for communities that vary in their cultural, economic, or ecological conditions, which is a typical limitation to community-based participatory research (Minkler & Wallerstein, 2011). Second, while the qualitative and quantitative mixed method approach had been designed in order to strengthen through data triangulation, qualitative research is most often based on self-reported data, which is most vulnerable to social desirability bias (Creswell & Plano Clark, 2018). Third, in assessing longer-term behavioral or economic impacts of skill enhancement, the retrospective nature of the evaluation becomes a limiting factor, largely due to the short duration of the empowerment program. I would also like to point out that while the evaluation of the quality of eco-print products was quite thorough, it was also primarily focused on their aesthetic, technical, and purely qualitative indicators, whereas a life-cycle approach or environmental impact assessment may provide a more comprehensive perspective on sustainability. Limitations do not detract from the contributions of this study, rather, it emphasizes the situational context of the processes of empowerment, which calls for longitudinal studies and studies across and within communities to construct a comprehensive approach to the understanding of the evolution of creative capacity-building activities.

Future investigations can expand the current study by incorporating longitudinal and comparative methodologies to assess the enduring influence of community-based empowerment on the creative and economic aspects of sustainability. A longitudinal strategy enables researchers to understand the shifts in behavior, entrepreneurial activity, and environment of the participants, thus illuminating the long-lasting effects of empowerment (Bryman, 2016). In addition, comparative research of disparate cultures and geographical areas is vital to examine the flexibility of the eco-print empowerment framework and model in different socio-economic settings, as noted by Creswell and Creswell (2018). Also, the future incorporation of environmental life-cycle assessment (LCA) methodologies in and around the planned studies would provide a better grasp of the eco-implications of eco-printing (Bocken et al., 2019). Methodologically, the use of digital ethnography or digitally enhanced participatory action research might provide richer data and advocate higher stakeholder participation, especially in the documentation of co-learning. Future research could examine the nexus of social empowerment of women, entrepreneurial creativity, and sustainable design education to develop innovative models for the green creative industry. Such studies would fill the current study's research gaps and be a great influence for theory and policy on the innovation of sustainable community development.

The social and ethical implications here not only include improvements to the quality of eco-print products but also include issues of equity, justice, and sustainable community development. Their empowerment programs focus on women as active creators rather than passive workers. This strengthens the ethical basis for inclusion and social justice, accompanying Sen's (1999) development theory, as freedom of agency and human dignity are core constituents of social development. The participatory approach in this study is also in harmony with UNESCO (2023) on the ethical engagement of communities that promotes community participation in decision-making and is characterized by transparency and respect for local systems of knowledge. Eco-printing with locally sourced plants and natural dyes is a demonstration of environmental stewardship and aligns with circular design, sustainable production (Fletcher & Tham, 2019), and social responsibility. The collaboration that the community program fosters amongst PKK women supports and strengthens community identity and the intergenerational transfer of knowledge, both of which are essential for the development of resilient local economies. Nevertheless, as the

market for eco-print products expands, communities should be guaranteed equitable access, fair payment, and protection of their intellectual property rights. The study reaffirms that, within the creative industries, ethically sustainable practice entails not only a commitment to ecological stewardship but also to the inclusion of equity, preservation of culture, and communal empowerment as foundational pillars of innovative responsibility.

4. CONCLUSION

The community-based empowerment program in Gunungpati, Semarang, positively affected the quality of eco-print products made by the PKK group women members. There were the main technical outcomes, such as improved color fastness, clearer and more consistent patterns, and neat finishing quality. The product quality rubric was used to measure, and most of the participants fell into the “good” category, which meant that training and mentoring were successful in overcoming the initial technical limitations of the community.

Moreover, the program empowered the technical people positively. The women became more self-confident, more creative, more willing to experiment with eco-print designs, and more cooperative, especially during the production activities. This is a clear transition from being dependent on the external facilitators to taking the lead in collective capacity building in eco-print production, thus contributing to the women-led creative activities at the community level.

An evaluation of the program concluded that the initial success indicators were mainly met, such as product quality, participation level, participants' satisfaction, and outputs availability, like eco-print products and a draft Basic production SOP. At the same time, participants shared a commitment to go ahead with eco-print production through group-based collaboration and marketing efforts. However, to keep and expand these initiatives, the community must rely on continuous mentoring, materials and equipment supply, group organization, and local market access support. The community's eco-print-based creative enterprises may be further strengthened and become more sustainable in the long run if future activities concentrate on the enhancement of marketing techniques, the increase of production reliability, and the widening of collaborations.

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