



## **Implementing Green Industry Principles Through Ecoprint Batik Making: A Nature-Care Initiative in Elementary Education**

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Received: 2025-10-28; Accepted: 2026-1-30; Published: 2026-3-12

### **ABSTRACT**

The implementation of green industry principles has become increasingly urgent in addressing environmental impacts of industrial activities. Environmental education from an early age through innovative approaches such as ecoprint batik can foster environmental stewardship among elementary students. This study aims to examine the implementation of green industry principles through ecoprint batik-making activities as an environmental education initiative at Elementary School 2 Kerandon, Indonesia. This research employed a descriptive qualitative design. Data were collected through observation, semi-structured interviews, and documentation involving sixth-grade students, teachers, and learning activities. Content analysis was used to analyze qualitative data from observations, interviews, and documentation of the ecoprint batik-making process. The ecoprint batik-making activities successfully increased students' environmental awareness and fostered creativity through utilization of natural materials including leaves, flowers, and natural dyes. The activity created contextual and engaging learning experiences that effectively introduced green industry concepts to elementary students. Students demonstrated improved understanding of environmental conservation and showed enthusiasm in creating unique batik patterns using environmentally friendly techniques. Integrating green industry values through ecoprint batik activities in elementary schools serves as an effective initial step in developing environmentally conscious character in children from an early age. This approach combines cultural preservation, environmental education, and practical skill development.

**Keywords:** *Green industry, ecoprint batik, environmental education, nature care.*

## INTRODUCTION

Environmental issues have emerged as critical global concerns, characterized by escalating global warming, pollution across multiple environmental media, and intensifying climate crises (UNIDO, 2011). The concept of "green industry" has been proposed as a strategic response, emphasizing efficient, environmentally friendly, and sustainable production processes (United Nations Conference on Sustainable Development, 2012). Internationally, countries are driving industrial transformation aligned with environmental sustainability principles, with particular emphasis on small and medium enterprises (SMEs) in developing nations (UNCTAD, 2021).

In Indonesia, green industry implementation is increasingly evident, particularly in SME sectors that contribute significantly to the economy while generating industrial waste (Baharuddin et al., 2022). The conventional batik industry presents notable environmental challenges, as traditional and modern production processes often utilize hazardous chemicals including synthetic dyes, caustic soda, and cleaning agents that can pollute water and damage ecosystems without proper management (Handayani et al., 2018; Martuti et al., 2020). Research indicates that untreated batik wastewater exhibits mutagenic and carcinogenic properties, adversely affecting both environmental and public health (Budiyanto et al., 2018; Ashari et al., 2022).

Ecoprint batik emerges as an innovative solution, utilizing natural materials such as leaves, flowers, and tree bark as color and pattern sources. This technique aligns strongly with green industry principles by utilizing local biodiversity without producing hazardous waste (Martuti et al., 2020; Fauzi et al., 2023). Natural dyes have been demonstrated to be biodegradable, harmless, and produce significantly less toxic liquid waste compared to synthetic alternatives (Felaza & Priadi, 2016). Furthermore, this technique is relatively simple to implement and suitable for educational settings, including elementary schools (Maher & Yoo, 2018).

Elementary schools play crucial roles in instilling environmental care values from early ages. Direct experiential-based learning activities enable students to more readily understand the importance of environmental protection (Ardoin et al., 2020; Kosta et al., 2022). Environmental education programs can be implemented creatively, including through ecoprint batik-making activities (Sarbaini et al., 2022). Such activities not only teach practical skills but also instill values of environmental stewardship, creativity, and cooperation (Hadjichambis et al., 2015).

Research on environmental education in elementary settings has shown positive impacts on students' environmental awareness and behavior (Yeşilyurt

et al., 2020; Yıldız Yılmaz & Mentiş Taş, 2018). Qualitative approaches are particularly appropriate for assessing processes and measuring outcomes with younger audiences, as they provide deeper insights into students' experiences and learning processes (Ardoin et al., 2018). Studies have demonstrated that hands-on environmental education activities significantly increase students' knowledge and foster positive attitudes toward environmental conservation (Hoang, 2021).

The ecoprint batik-making training at Elementary School 2 Kerandon involving sixth-grade students was designed to introduce environmentally friendly concepts to children from early ages. At this developmental stage, children are in character and habit-forming phases, making introduction to ecoprint techniques an effective means of instilling environmental stewardship (Otto et al., 2019; Toth, 2016). By utilizing natural materials readily available around the school, this training provides practical experience on wise natural resource utilization (Kolb, 1984; Gündüz et al., 2018).

This research addresses the gap in empirical studies examining the integration of green industry principles in elementary education through traditional craft techniques. While previous studies have explored environmental education in schools, limited research has investigated how indigenous practices like ecoprint batik can serve as vehicles for environmental education and character building in elementary settings. Therefore, this study investigates: How do ecoprint batik-making activities implement green industry principles in elementary education? What impacts do these activities have on students' environmental awareness and creativity?

## **METHOD**

### **Research Design**

This study employed a descriptive qualitative research design to examine the implementation and impacts of ecoprint batik-making activities in elementary education. Qualitative methods are particularly appropriate for environmental education research with young participants, as they allow for in-depth exploration of experiences, perceptions, and learning processes (Creswell & Creswell, 2018; Ardoin et al., 2018). Descriptive qualitative research enables rich, detailed descriptions of phenomena in their natural contexts (Miles et al., 2014).

### **Research Setting and Participants**

The research was conducted at Elementary School 2 Kerandon, Indonesia, during the 2023 academic year. Participants included sixth-grade students

(n=30), classroom teachers (n=2), and community service program students from Islamic University of Bunga Bangsa Cirebon who facilitated the activities. Sixth-grade students were selected as they are at appropriate developmental stages for understanding environmental concepts and engaging in hands-on creative activities (Piaget, 1976; Otto et al., 2019).

### **Data Collection**

Data were collected through multiple methods to ensure triangulation and enhance credibility:

1. **Observation:** Structured observations were conducted throughout the ecoprint batik-making activities. Observation protocols focused on students' engagement, skill development, understanding of green industry concepts, and interactions with natural materials. Field notes documented students' behaviors, questions, and creative processes.
2. **Interviews:** Semi-structured interviews were conducted with participating teachers (n=2) and selected students (n=10) following activity completion. Interview guides explored perceptions of the activity, understanding of environmental concepts, and impacts on environmental awareness. Interviews lasted approximately 20-30 minutes and were audio-recorded with permission.
3. **Documentation:** Photographic and video documentation captured the ecoprint process stages, students' work products, and activity dynamics. Student artifacts (completed ecoprint batik pieces) were collected and analyzed for creativity and technique application.

### **Data Analysis**

Data analysis followed qualitative content analysis procedures (Miles et al., 2014). The analysis process included:

1. **Data Organization:** All observational notes, interview transcripts, and documentation were organized chronologically and by activity stage.
2. **Coding:** Initial coding identified themes related to environmental awareness, creativity, skill development, and understanding of green industry principles. Descriptive codes were applied to data segments.
3. **Category Development:** Related codes were grouped into broader categories representing major findings and patterns.
4. **Theme Identification:** Categories were analyzed to identify overarching themes regarding implementation and impacts of ecoprint activities.
5. **Interpretation:** Themes were interpreted in relation to research questions and existing literature on environmental education and green industry principles.

## **Implementation Procedures**

The ecoprint batik-making program followed systematic stages based on Asset-Based Community Development (ABCD) principles (Kretzmann & McKnight, 1993) and Science and Technology Diffusion methods:

**Planning Stage:** Initial assessment identified student interests and available natural resources. Training materials were developed appropriate to sixth-grade comprehension levels.

**Socialization Stage:** Introductory sessions educated students about ecoprint batik concepts, green industry principles, and environmental conservation importance.

**Practical Training Stages:**

1. Material gathering from school environment
2. Fabric preparation with natural mordants
3. Leaf and flower application techniques
4. Pattern transfer through pounding and steaming
5. Color fixation and washing processes
6. Product finishing

**Dissemination Stage:** Students' work was shared through social media and school exhibitions to raise awareness and appreciation.

## **RESULTS AND DISCUSSION**

### **Implementation of Green Industry Principles**

The ecoprint batik-making activities successfully integrated multiple green industry principles into elementary education through systematic processes that minimized environmental impact while maximizing educational value.

**Utilization of Natural Resources:** Students learned to identify and collect appropriate natural materials from their school environment, including leaves from various plants (teak, mango, ketapang) and flowers. This direct engagement with local biodiversity fostered appreciation for natural resources and understanding of sustainable material sourcing. As one teacher noted: "Students became more observant of the plants around them. They started asking questions about which leaves could be used and why certain plants produce different colors."

**Waste Minimization:** The ecoprint process produced minimal waste compared to conventional batik production. All materials used—natural mordants (alum, salt), plant materials, and water—were biodegradable and non-toxic. Students observed that wastewater from ecoprint could be safely returned to the environment, contrasting sharply with hazardous chemical wastes from synthetic dyeing.

Energy Efficiency: The techniques employed (pounding, steaming, natural drying) required minimal energy input. Students noted the simplicity of processes and contrast with industrial production methods. One student commented: "We don't need machines or electricity to make beautiful patterns. We can use what nature gives us."

### **Development of Environmental Awareness**

Analysis of observations, interviews, and student reflections revealed significant increases in environmental awareness across multiple dimensions.

Knowledge Dimension: Post-activity interviews demonstrated students' enhanced understanding of:

1. Environmental problems associated with conventional batik production
2. Benefits of natural versus synthetic materials
3. Concepts of biodegradability and pollution
4. Local plant biodiversity and their properties

Students articulated connections between their ecoprint activities and broader environmental issues. For example: "Before, I didn't know that making batik could hurt rivers and animals. Now I understand why using natural leaves is better for nature."

Affective Dimension: Students exhibited increased emotional connections to nature and environmental concern. Observations documented students' careful handling of plant materials, expressed appreciation for natural beauty, and concern about environmental protection. Student reflections included statements like: "I feel sad when I see trash in the river now because I know it harms nature. We should take care of our environment like the plants take care of us by giving us colors."

Behavioral Dimension: Teachers reported observable changes in students' environmental behaviors, including:

1. Reduced littering and increased recycling participation
2. Greater interest in school gardening activities
3. Peer education about environmental issues
4. Requests to learn more about sustainable practices
5. One teacher observed: "After the ecoprint activity, students became more conscious about waste. They remind each other to separate trash and even suggested starting a composting program."

### **Enhancement of Creativity and Skills**

The ecoprint batik activities significantly fostered students' creativity and practical skill development.

Creative Expression: Students demonstrated creativity in:

1. Selecting and arranging leaf and flower patterns
2. Experimenting with color combinations
3. Designing unique layouts on fabric
4. Problem-solving when techniques didn't work as expected

Analysis of student products revealed diverse, individualized designs reflecting personal aesthetic preferences and creative thinking. Students experimented with overlapping leaves, creating symmetrical patterns, and combining different plant materials to achieve desired effects.

1. Technical Skills: Students developed practical skills including:
  - a. Proper handling and preparation of natural materials
  - b. Application of mordanting techniques
  - c. Pattern transfer through pounding and steaming methods
  - d. Color fixation processes
  - e. Quality control and finishing techniques

Observation notes documented progressive skill improvement throughout the activity. Initial attempts showed uneven patterns and incomplete color transfer, while later productions demonstrated refined techniques and higher quality results.

2. Collaboration and Social Skills: The group-based nature of activities fostered collaboration. Students worked in teams to:
  - a. Gather materials cooperatively
  - b. Share techniques and problem-solving strategies
  - c. Provide peer feedback on designs
  - d. Support each other through challenging process steps

Teachers noted improved teamwork and communication skills, particularly among students who typically struggled with collaborative tasks.

### **Learning Process and Engagement**

The experiential, hands-on nature of ecoprint activities created highly engaging learning experiences.

1. Active Participation: Observations revealed consistent high engagement levels throughout activities. Students demonstrated:
  - a. Sustained attention and focus during demonstrations
  - b. Enthusiastic participation in hands-on practice
  - c. Voluntary exploration beyond required tasks
  - d. Persistent problem-solving efforts when facing difficulties

One student commented: "This is the most fun learning I've ever done. I didn't want to stop even when it was break time."

2. **Meaningful Learning:** Students made connections between ecoprint activities and broader concepts:
  - a. Linking traditional culture with environmental sustainability
  - b. Understanding industrial impacts on environment
  - c. Recognizing local resources and their potential
  - d. Connecting classroom knowledge to real-world applications
3. A teacher reflected: "Students understood abstract environmental concepts much better through this concrete experience. They could see and touch the results of using natural materials."

**Cultural Appreciation:** The activity fostered appreciation for Indonesian batik heritage and traditional knowledge. Students expressed pride in cultural traditions and interest in preserving indigenous practices. Comments included: "I'm proud that Indonesia has batik. We should keep making it in ways that don't hurt nature like our ancestors did."

### **Challenges and Solutions**

Several challenges emerged during implementation, along with adaptive solutions:

1. **Material Availability:** Some plant species provided inconsistent color results due to seasonal variations. **Solution:** Teachers developed guides identifying reliably available plants for each season.
2. **Technique Mastery:** Students initially struggled with even pressure application during pounding. **Solution:** Practice sessions with waste fabric allowed skill development before final products.
3. **Time Constraints:** Complete ecoprint processes required extended time periods. **Solution:** Activities were structured across multiple sessions, integrating with regular curriculum where possible.
4. **Individual Differences:** Students exhibited varying skill levels and creative confidence. **Solution:** Peer mentoring and differentiated support ensured all students achieved success.

### **DISCUSSION**

This study demonstrates that ecoprint batik-making activities effectively integrate green industry principles into elementary education while fostering environmental awareness, creativity, and practical skills. Findings align with and extend existing literature on environmental education and sustainability in primary schooling.

## **Green Industry Principles in Elementary Education**

The successful integration of green industry principles through ecoprint activities supports arguments that sustainability concepts can be meaningfully introduced to young learners through appropriate pedagogical approaches (Boeve-de Pauw et al., 2020). This study contributes empirical evidence that elementary students can understand and apply principles such as resource efficiency, waste minimization, and use of renewable materials when presented through concrete, experiential activities.

The ecoprint process exemplifies circular economy principles increasingly recognized as essential for sustainable development (Kirchherr & Piscicelli, 2019). By utilizing locally available natural materials and producing biodegradable products with minimal waste, students directly experienced alternatives to linear "take-make-dispose" models. This early exposure may foster lifelong patterns of sustainable consumption and production.

Findings resonate with research demonstrating effectiveness of hands-on, experiential approaches for environmental education (Ardoin et al., 2020). The tangible nature of ecoprint activities – touching leaves, observing color transfer, seeing final products – provided concrete referents for abstract sustainability concepts. This aligns with Kolb's (1984) experiential learning theory and Piaget's emphasis on concrete operational thinking in elementary-aged children.

## **Environmental Awareness Development**

Observed increases in students' environmental awareness across knowledge, affective, and behavioral dimensions confirm findings from similar environmental education interventions (Yeşilyurt et al., 2020; Hoang, 2021). Notably, the emotional connections students formed with nature through working directly with plant materials reflect importance of nature contact for environmental attitude development (Chawla, 2015).

The behavioral changes teachers reported – reduced littering, increased recycling, peer education – suggest that impacts extended beyond immediate activity context. This transfer of learning to broader environmental behaviors is critical outcome of environmental education (Otto et al., 2019). The finding that students initiated additional environmental actions voluntarily indicates development of intrinsic motivation for environmental stewardship.

Students' ability to articulate connections between ecoprint activities and broader environmental issues (e.g., chemical pollution from conventional batik) demonstrates critical thinking development. This capacity to analyze systemic environmental problems is essential for education for sustainable development

(UNESCO, 2014). The study extends understanding of how traditional practices can serve as entry points for discussing contemporary environmental challenges.

### **Creativity and Skill Development**

The significant enhancement of creativity observed aligns with literature on benefits of arts-based approaches for holistic child development (Davis & Elliott, 2014). Ecoprint activities required students to think divergently, experiment, and express individual aesthetic preferences while working within natural material constraints. This balance of structure and freedom characterizes effective creative learning environments.

Development of both technical and social skills through collaborative ecoprint activities supports arguments for integrated, project-based learning approaches (Maher & Yoo, 2018). Students simultaneously learned craft techniques, practiced teamwork, and applied problem-solving skills—competencies valuable beyond environmental education.

The cultural dimension of skill development deserves emphasis. By learning traditional ecoprint techniques, students connected with Indonesian heritage while adapting practices for contemporary sustainability goals. This integration of cultural preservation and environmental innovation exemplifies education approaches promoting both sustainability and cultural vitality (Davis, 2010).

### **Pedagogical Implications**

Findings suggest several pedagogical implications for elementary environmental education:

1. **Experiential Learning Priority:** Hands-on activities with tangible outcomes proved highly engaging and educationally effective. Educators should prioritize experiential approaches over purely didactic environmental instruction.
2. **Local Resources and Context:** Using locally available natural materials and addressing community-relevant issues (batik industry impacts) made learning meaningful and culturally appropriate. Place-based education principles should guide curriculum development (Sobel, 2004).
3. **Integration Across Domains:** Ecoprint activities simultaneously addressed environmental education, cultural preservation, art education, and skill development. Integrated, interdisciplinary approaches maximize educational efficiency and demonstrate real-world complexity.
4. **Scaffolded Skill Building:** Providing practice opportunities, peer support, and differentiated assistance enabled all students to achieve success despite

varying abilities. Inclusive instructional design ensures environmental education reaches all learners.

### **Implications for Green Industry Education**

This study demonstrates feasibility and value of introducing green industry concepts in elementary education. Early exposure to sustainable production principles may influence future consumer behaviors and career choices. As students progress through education, foundational understanding developed through activities like ecoprint can be built upon with increasingly sophisticated sustainability concepts.

The positive response from students, teachers, and community suggests appetite for expanded green industry education. Schools should consider developing comprehensive sustainability curricula incorporating multiple industries and contexts, using ecoprint as one exemplar approach.

Partnership models demonstrated in this study—university students facilitating school activities—offer scalable frameworks for expanding environmental education access. Similar collaborative programs could address resource and expertise limitations often constraining school environmental initiatives.

### **Limitations and Future Research**

Several limitations warrant consideration. First, the relatively short intervention period and focus on one school limit generalizability. Longitudinal research across multiple schools and contexts would strengthen understanding of long-term impacts and broader applicability.

Second, while qualitative methods provided rich insights, quantitative measures of environmental knowledge, attitudes, and behaviors would enable more precise assessment of intervention effects. Future research should employ mixed methods approaches combining qualitative depth with quantitative measurement.

Third, this study focused on student and teacher perspectives. Incorporating parent and community viewpoints would provide more comprehensive understanding of program impacts and sustainability.

#### **Future research should investigate:**

1. Long-term retention of environmental awareness and behaviors developed through ecoprint activities
2. Comparative effectiveness of different environmental education approaches in elementary settings

3. Scalability of ecoprint programs to larger student populations and resource-constrained contexts
4. Integration of ecoprint activities with formal curriculum standards and learning objectives
5. Impacts of teacher training on quality and outcomes of environmental education programs

Community-level environmental impacts when school environmental education reaches families and neighborhoods.

## CONCLUSION

This study demonstrates that ecoprint batik-making activities effectively implement green industry principles in elementary education while fostering environmental awareness, creativity, and practical skills among students. The experiential, hands-on nature of activities created engaging learning experiences that made abstract sustainability concepts concrete and meaningful for young learners.

**Successful Integration of Green Industry Principles:** Ecoprint activities effectively introduced concepts of sustainable resource use, waste minimization, and environmentally friendly production to elementary students through accessible, age-appropriate methods.

**Enhanced Environmental Awareness:** Students demonstrated increased environmental knowledge, developed stronger emotional connections to nature, and exhibited positive behavioral changes extending beyond immediate activity contexts.

**Creativity and Skill Development:** Activities fostered creative expression, technical skill acquisition, and collaborative abilities while connecting students with cultural heritage and traditional knowledge.

**Effective Pedagogical Approach:** Experiential, place-based learning using local resources proved highly engaging and educationally effective for elementary environmental education.

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