

DEVELOPMENT OF A MODEL FOR INTEGRATING GREEN SKILLS INTO THE VOCATIONAL FASHION DESIGN CURRICULUM TO SUPPORT EMPLOYABILITY IN THE SUSTAINABLE FASHION INDUSTRY

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ABSTRACT

The transition toward a green economy has significantly transformed various industrial sectors, including the fashion industry, which is recognized as one of the largest contributors to environmental degradation. This condition requires a workforce equipped with green skills to support sustainable industry practices. Vocational education plays a strategic role in preparing graduates for these demands; however, the integration of green skills into vocational curricula remains limited. This study aims to develop a conceptual model for integrating green skills into the vocational fashion curriculum to enhance work readiness in the sustainable fashion industry. This study employs a qualitative approach using a literature review method. The findings reveal that the proposed model consists of four main components: sustainability-based curriculum content, project-based learning strategies, industry collaboration, and competency-based assessment. The model is expected to improve curriculum relevance and strengthen graduates' work readiness.

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INTRODUCTION

Climate change, environmental degradation, and the exploitation of natural resources have become increasingly urgent global challenges in recent decades. Reports from various international organizations indicate that industrial activity is one of the primary contributors to carbon emissions, environmental pollution, and ecosystem damage (OECD, 2023; World Economic Forum, 2023). In this context, the transition toward a green economy has become a global strategic agenda aimed at balancing economic growth with environmental sustainability.

One sector receiving particular attention is the fashion industry. This sector not only contributes significantly to the global economy, but is also recognized as one of the industries with the highest environmental impact. Research shows that the fashion industry generates massive amounts of textile waste, excessive water consumption, and

significant greenhouse gas emissions (Bick et al., 2018; Niinimäki et al., 2020). The fast fashion phenomenon has further aggravated this situation by driving excessive consumption and unsustainable production cycles.

In response to these problems, the concept of sustainable fashion has emerged, emphasizing production and consumption practices that are more environmentally responsible. This concept encompasses the use of eco-friendly materials, energy efficiency, waste reduction, and the application of circular economy principles within the fashion supply chain (Gwilt, 2020; Kozłowski et al., 2018). The transition toward a sustainable fashion industry requires not only technological innovation, but also a transformation in workforce competencies.

This shift in workforce competency needs is reflected in the growing demand for green skills. Green skills refer to a set of knowledge, abilities, values, and attitudes that enable individuals to work effectively within the context of environmental sustainability (Pavlova, 2016). These competencies encompass not only technical aspects, but also critical thinking, problem-solving, and a heightened environmental awareness (Wiek et al., 2011).

In the context of education, particularly vocational education, the development of green skills is of great importance. Vocational education plays a strategic role in preparing a workforce that is job-ready and aligned with industry needs (Rauner & Maclean, 2008). Hence, integrating green skills into vocational education curricula is a crucial step in ensuring that education remains relevant to the demands of the working world.

However, various studies indicate that the integration of green skills into vocational education still faces numerous challenges. Existing curricula tend to focus on conventional technical skills and have not yet systematically incorporated sustainability principles (Sern et al., 2021). Further, limited resources, insufficient teacher training, and a lack of industry collaboration also serve as barriers to implementing sustainability-based education.

Within the context of fashion vocational education, these challenges become even more complex. The fashion industry has unique characteristics, with competency requirements that continuously evolve alongside global trends and technological innovation. A more systematic and integrative approach is therefore needed in developing curricula capable of accommodating green skills requirements.

Based on this background, this study aims to develop a model for integrating green skills into the vocational fashion education curriculum. The model is expected to serve as a reference for developing curricula that are more relevant, adaptive, and sustainability-oriented, while also improving graduates' work readiness in meeting the demands of the sustainable fashion industry.

In the Indonesian context, developing green skills in vocational education is increasingly important given the high unemployment rate among vocational high school (SMK) graduates and the gap between graduate competencies and industry needs (Muaddab et al., 2024). Several studies have shown that the implementation of green skills in SMKs is still suboptimal and tends to be fragmented (Haloho et al., 2023; Saputri & Ediyono, 2022). A systematic and contextually appropriate integration model is therefore needed to address national requirements.

LITERATURE REVIEW

Green Skills and Economic Transformation

The concept of green skills emerged as a response to workforce demands within the green economy. As noted by Pavlova (2016), green skills encompass both technical and non-technical abilities that support sustainable practices across various industrial sectors. These competencies include knowledge of environmentally friendly technologies, resource efficiency, and awareness of the environmental impact of economic activities.

A research shows that green skills have become a key factor in enhancing workforce competitiveness in the green economy era (Kóczyás & Demirel, 2025). Furthermore, the World Economic Forum (2023) report also emphasizes that demand for sustainability-based competencies will continue to rise in line with global industrial transformation.

Research in Indonesia indicates that teachers' and students' understanding of green skills remains at varying levels and has not yet been comprehensively integrated into curricula (Handayani et al., 2020). Further, project-based learning approaches have proven effective in improving sustainability competencies among vocational students (Fitriyanto et al., 2021).

Vocational Education and Green Skills

Vocational education is essential in developing green skills due to its focus on practical skill development and work readiness (Rauner & Maclean, 2008). The integration of green skills into vocational education can be achieved through various approaches, including curriculum development, project-based learning, and industry collaboration (Maclean & Pavlova, 2013).

However, the implementation of sustainability-based education in vocational settings continues to face numerous challenges. Research by Sern et al. (2021) reveals that many vocational education institutions do not yet have curricula that explicitly integrate green skills, highlighting the need for innovation in curriculum development.

Sustainable Fashion and Competency Requirements

The sustainable fashion industry demands a workforce equipped with specific competencies in the area of sustainability. These competencies include the ability to select eco-friendly materials, manage textile waste, and apply circular economy principles throughout the production process (Niinimäki et al., 2020).

According to Gwilt (2020), fashion education needs to transform in order to accommodate the demands of a sustainable industry. This involves integrating sustainability concepts into curricula, as well as developing teaching methods that foster innovation and creativity.

METHODS

This study employs a qualitative approach using the Systematic Literature Review (SLR) method. SLR was selected to systematically identify, evaluate, and synthesize research relevant to the integration of green skills in vocational education, particularly in the field of fashion/clothing studies.

The SLR process in this study follows the general stages of planning, execution, and reporting. During the planning stage, the researchers formulated the following research questions: (1) how is the concept of green skills understood within vocational education, (2) what are the competency demands of the sustainable fashion industry for its workforce, and (3) what model can be used to integrate green skills into the vocational education curriculum.

During the execution stage, the researchers performed a literature search across various scientific databases, including Google Scholar, Scopus, and publications from international institutions. Keywords used in the search included "green skills," "vocational education," "TVET," "sustainable fashion," and "curriculum integration." The search was limited to articles published within the past ten years to ensure the relevance and currency of the data.

Inclusion criteria for this study comprised: (1) scientific articles addressing green skills or sustainability-based vocational education, (2) research relevant to curriculum development or work competencies, and (3) publications in reputable national or international journals. Exclusion criteria included: (1) articles without direct relevance to the research topic, (2) non-scientific publications, and (3) articles with incomplete information.

The literature selection process was carried out through several stages: identification, screening, eligibility assessment, and inclusion. During the identification stage, all literature retrieved from the search was compiled. This was followed by screening based on titles and abstracts to eliminate irrelevant sources. The next stage involved an eligibility assessment based on the full content of each article. In the final stage, literature meeting the inclusion criteria was used as the basis for analysis.

Data analysis was conducted using a descriptive-analytical approach with thematic synthesis. The analytical stages included: (1) coding of key concepts from the selected literature, (2) grouping of themes related to green skills, vocational education, and the sustainable fashion industry, and (3) synthesizing findings to formulate a model for integrating green skills into the fashion vocational education curriculum.

To ensure the validity and reliability of the findings, source triangulation was carried out by cross-referencing various sources from journals, books, and international reports. Furthermore, the literature selection and analysis process was conducted in a systematic and transparent manner, ensuring that the resulting model has a strong theoretical foundation and is scientifically accountable. The literature selection process in this study follows a simplified version of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework.

RESULTS AND DISCUSSION

Integration of Green Skills into the Curriculum

The integration of green skills into the vocational fashion education curriculum can be achieved by strengthening sustainability-based learning content. This includes introducing the concept of eco-fashion, the use of environmentally friendly materials, and textile waste management.

According to UNESCO (2021), education for sustainability must integrate environmental, social, and economic aspects into the learning process. As such, the vocational education curriculum needs to be designed holistically to accommodate the various dimensions of sustainability.

Green Skills-Based Learning Strategies

The development of green skills in vocational education cannot be separated from the learning strategies employed. Traditional teacher-centered learning approaches are considered less effective in developing 21st-century competencies, including green skills, which require critical thinking, problem-solving, and collaboration (Wiek et al., 2011).

One effective approach is project-based learning (PjBL). This approach allows students to engage actively in the learning process through projects relevant to the real world. In the context of fashion education, projects may involve designing sustainable fashion products, using eco-friendly materials, or transforming textile waste into value-added products. Research shows that PjBL can significantly enhance students' critical thinking skills and creativity (Jackson, 2014).

Beyond to PjBL, problem-based learning (PBL) can also be used to develop green skills. Through PBL, students are confronted with real problems related to environmental issues in the fashion industry, such as textile waste or the use of hazardous chemicals. This approach encourages students to seek innovative and sustainable solutions.

Experiential learning also plays an important role in developing green skills. Through direct experience, students can gain a deeper understanding of industry practices and their environmental impact. This aligns with the concept of contextual learning, which emphasizes the connection between theory and practice. Accordingly, project-based, problem-based, and experiential learning strategies constitute essential components of the green skills integration model within the vocational education curriculum.

Studies in Indonesia illustrate that the application of project-based learning and project citizen models has proven effective in improving students' ability to manage waste and produce recycled-based products as part of green skills development (Handayani et al., 2020; Nurdiansyah et al., 2019).

Industry Collaboration in Green Skills Development

Collaboration between educational institutions and industry is a key factor in improving the relevance of vocational education. Such partnerships enable students to gain direct work experience and develop a genuine understanding of industry needs (Li & Pilz, 2023).

In the context of the sustainable fashion industry, collaboration can take various forms, including internship programs, teaching factories, and collaborative projects with industry partners. Internship programs allow students to be directly involved in the production process and to understand the sustainability practices applied by the industry.

Additionally, the involvement of industry practitioners as resource persons or guest lecturers can enrich students' learning experiences, enabling the transfer of knowledge and expertise from industry to the educational sphere. Research by Li & Pilz (2023) illuminates that industry collaboration can enhance the quality of learning and improve graduates' work readiness. Hence, integrating industry collaboration into the curriculum is an important component of the developed model.

Green Skills Competency-Based Assessment

Assessment is an essential part of the learning process for measuring students' competency attainment. In the context of green skills, evaluation encompasses not only cognitive aspects, but also affective and psychomotor dimensions (Putri et al., 2025).

Project-based assessment can be used to measure students' ability to apply sustainability concepts in practice. Portfolios can also serve as an evaluation tool to document students' work related to green skills. The assessment of environmental attitudes and awareness also forms an important part of evaluation. This can be carried out through observation, self-reflection, and rubric-based assessment. Green skills competency-based evaluation must therefore be designed comprehensively to cover the full range of competency aspects.

Synthesis of the Green Skills Integration Model

Based on the literature review and analysis performed, the model for integrating green skills into the vocational fashion education curriculum consists of four main components: (1) integration of sustainability-based curriculum content, (2) project-based and experiential learning strategies, (3) industry collaboration, and (4) competency-based assessment. These four components are interrelated and form an integrated system. The model is also dynamic in nature, meaning it can be adapted to evolving industry needs and educational policy developments.

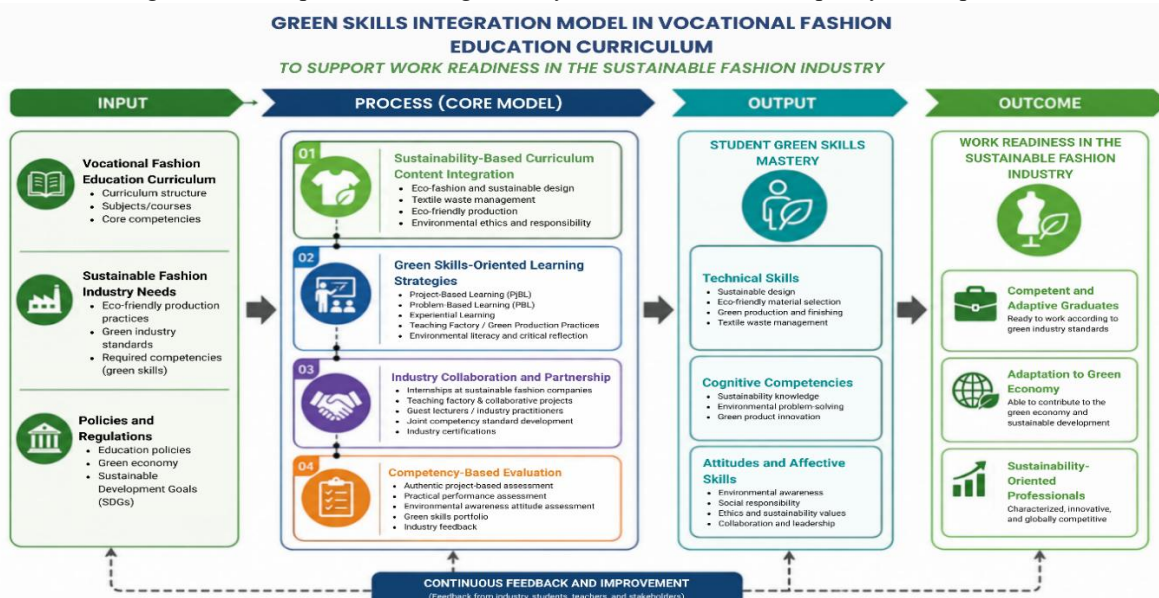


Figure 1. Integration Model of Green Skills in the Vocational Fashion Education Curriculum to Enhance Work Readiness in the Sustainable Fashion Industry

The green skills integration model developed in this study has several strengths. First, it is holistic in nature, encompassing various educational components ranging from curriculum design to assessment. Second, the model is flexible and can be adapted to a variety of educational contexts.

Nevertheless, the implementation of this model also faces a number of challenges. One of the primary challenges is the readiness of educators to integrate green skills into their teaching. Many teachers do not yet have sufficient understanding of sustainability concepts or how to implement them in the classroom.

Furthermore, limited facilities and resources also present obstacles to applying this model. The use of eco-friendly materials or sustainable production technologies, for instance, can entail considerable costs. The successful implementation of this model therefore requires support from multiple stakeholders, including the government, educational institutions, and industry. Teacher training and the provision of adequate facilities are critical factors in ensuring effective implementation.

Research Implications

1) Theoretical Implications

This study makes a theoretical contribution by developing a green skills integration model that combines perspectives from vocational education, sustainability, and industry needs. The model extends the concept of green employability skills by emphasizing the practical aspects of curriculum implementation. Furthermore, the study affirms the importance of a systemic approach to developing sustainability-based curricula, one that addresses the full range of educational components in a holistic manner.

2) Practical Implications

In practical terms, the developed model can serve as a reference for (1) curriculum developers, (2) teachers and educators, and (3) educational policymakers. Implementing this model can help improve the relevance of vocational education and enhance graduates' work readiness in meeting the demands of the sustainable fashion industry.

Recent research also indicates that the level of green skills maturity among vocational teachers and students in Indonesia still requires strengthening, particularly in terms of learning implementation and competency assessment (Mutohhari et al., 2025). The integration of green skills into vocational education in Indonesia carries considerable urgency, in line with the nation's commitment to sustainable development. The Indonesian government has adopted various policies supporting the transition toward a green economy, including through the strengthening of vocational education that is responsive to industry needs.

In the context of fashion education at Vocational High Schools (SMK), the current curriculum still tends to focus on technical skills such as design, pattern making, and garment production. Although some sustainability elements have begun to be introduced, the integration of green skills remains partial and unsystematic. This is consistent with findings from various studies indicating that vocational education in developing countries continues to face challenges in comprehensively integrating sustainability principles.

Moreover, limited facilities and resources continue to hinder the implementation of sustainability-based learning. The use of eco-friendly materials or sustainable production technologies, for example, remains restricted in many vocational education institutions. An adaptive and contextually appropriate approach to implementing the green skills integration model is therefore essential.

The implementation of the green skills integration model in the vocational fashion education curriculum can be carried out incrementally through several strategies. First, curriculum content can be strengthened by incorporating sustainability-related material into existing subjects. In fashion design, for instance, students can be introduced to the concept of eco-design and the use of environmentally friendly materials.

Second, project-based learning strategies can be applied through assignments that encourage students to create sustainable fashion products, involving the use of recycled materials or the repurposing of textile waste into new products. Third, industry collaboration can be reinforced through internship programs or partnerships in curriculum development, with industry providing input on competency needs and facilities for student practice. Fourth, competency-based assessment can be implemented through project evaluations, portfolios, and student reflections which measuring not only technical skills, but also environmental awareness and attitudes.

CONCLUSION

The development of a green skills integration model for the vocational fashion education curriculum represents a strategic step in addressing the challenges of the sustainable fashion industry. The model proposed in this study offers a systematic and integrative approach to developing student competencies that are relevant to industry needs.

Through the integration of curriculum content, learning strategies, industry collaboration, and competency-based assessment, this model is expected to improve the quality of vocational education and graduates' work readiness. It also supports the transformation of education toward a more sustainable and globally adaptive system. This study therefore makes a significant contribution to the development of sustainability-based vocational education and to broader global efforts in achieving sustainable development.

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Future research is recommended to conduct empirical testing of the developed model, as well as to explore its implementation across other vocational education disciplines. Additionally, policy support from the government and stronger collaboration between education and industry will be essential to ensuring the successful implementation of this model.

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