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Vocational Education Readiness in Preparing Green Jobs: Needs Analysis and Implementation Strategies

Feby[1], Tian Havwini[2], Rusyda Nazhirah Yunus[3], Desi Ratna Sari[4], Windy Stefani[5], Nurul Fadilah[6], Luki Aswar[7], Multhahada Ramadhani Siregar[8]
[1,2,3,4,5,6,7,8]Politeknik Negeri Batam, Indonesian

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ABSTRACT

The global transition toward a sustainable, low-carbon economy has significantly increased demand for green jobs, creating new challenges for vocational education institutions. However, many vocational curricula remain primarily oriented toward conventional industrial needs, raising concerns about their readiness to prepare graduates for green employment sectors. This study aims to analyze the readiness of vocational education, particularly at the polytechnic level, in preparing graduates for green jobs through a needs analysis and the development of implementation strategies. This research employed a mixed-method approach, combining qualitative and quantitative techniques. Data were collected through curriculum document analysis, questionnaires, interviews, and Focus Group Discussions (FGDs) involving lecturers, program representatives, and green job experts. The study focused on Batam State Polytechnic (Polibatam) as the research context. The findings indicate that vocational education readiness for green jobs remains at an emerging stage. Key gaps were identified in the integration of sustainability principles within institutional vision and mission statements, learning outcomes, curriculum content, teaching practices, lecturer competencies, and eco-friendly infrastructure. Although moderate alignment with industry collaboration and national policy frameworks was observed, the overall implementation of the curriculum remains fragmented. Based on expert validation through FGDs, this study proposes a prototype model for green curriculum integration that emphasizes institutional, curricular, instructional, and collaborative strategies.

Corresponding Author:

Feby
Politeknik Negeri Batam, Indonesian
Email: Feby@polibatam.ac.id

1. INTRODUCTION

The global transition toward a sustainable and low-carbon economy has accelerated the growth of *green jobs*, defined as occupations that contribute to environmental

preservation and resource efficiency [1]. International agreements such as the *Paris Agreement* [2] and the *Sustainable Development Goals* (SDGs), particularly Goal 4 (Quality Education) and Goal 8 (Decent Work and Economic Growth), emphasize the importance of developing human resources capable of supporting sustainable development [1], [3].

Vocational education plays a strategic role in preparing a skilled workforce aligned with labor market demands. However, the rapid expansion of green economic sectors presents new challenges for vocational institutions. Previous studies indicate that many vocational education systems remain predominantly oriented toward conventional industrial competencies, resulting in a mismatch between graduate skills and sustainability-driven workforce requirements [4]

In Indonesia, sustainability principles have been increasingly promoted through national development frameworks, including the *National Medium-Term Development Plan (RPJMN)* and policies supporting low-carbon development [5]. Despite these policy directions, the integration of green skills within vocational curricula remains inconsistent. Key challenges include limited sustainability orientation in institutional frameworks, uneven curriculum integration, inadequate lecturer competencies, and infrastructure constraints [6]

The research problem addressed in this study concerns the readiness of vocational education curricula to prepare graduates for green jobs. While sustainability concepts have been introduced in certain programs, empirical evidence suggests that their implementation often lacks systematic alignment across institutional, curricular, and instructional dimensions [5].

This study adopts a needs analysis approach to evaluate curriculum readiness and develop implementation strategies. Curriculum transformation is understood as a systemic process that requires alignment amongnstitutional policies, learning outcomes, instructional practices, and industry collaboration [7]. Therefore, this research examines readiness through a multidimensional analysis of curriculum documents, stakeholder perceptions, and expert validation.

The objectives of this study are:

a. To analyze the readiness of vocational education curricula in preparing graduates for green jobs.
b. To identify gaps in sustainability integration across institutional, curricular, and instructional components.
c. To formulate implementation strategies for strengthening green skills development.

This research is grounded in Human Capital Theory [8], which highlights the role of education in workforce development, and the Sustainability Transition Framework [9], which explains systemic adaptation to socio-technical changes. Within vocational education, green skills represent an extension of traditional competencies, incorporating environmental awareness, sustainable innovation, and resource efficiency [10].

Previous research has examined green skills development primarily from pedagogical and competency-based perspectives. Chola and Kiplagat [11] emphasize integrating sustainability into Technical and Vocational Education and Training (TVET), while Suhendra et al. [12] explore instructional strategies to enhance green competencies.

However, limited studies have analyzed curriculum readiness using a systemic institutional approach, particularly within Indonesian polytechnic education.

This study by Fitriyanto et al. [13] contributes to the literature by providing a multi-level curriculum-readiness analysis and proposing a prototype model for green curriculum implementation based on empirical findings and expert validation. The results are expected to support vocational institutions, curriculum developers, and policymakers in strengthening workforce preparation for green economic sectors [14].

2. METHOD

This study adopts a mixed-method approach combining qualitative and quantitative techniques to comprehensively analyze vocational education readiness in preparing graduates for green jobs [15]. The research was conducted at Batam State Polytechnic (Polibatam), focusing on the analysis of curriculum relevance, institutional policies, and stakeholders' perspectives related to the green economy and sustainable development [16].

2.1 Research Design

The study consists of three main stages:

a. Needs analysis: identification of gaps between current curriculum content and green job competency requirements.
b. Curriculum Mapping: examination of sustainability integration in learning outcomes, teaching materials, and learning activities.
c. Strategy Development: formulation of implementation strategies to enhance curriculum readiness for green job preparation.

Each stage is supported by data triangulation involving curriculum documents, expert validation, and stakeholder input from industry representatives, lecturers, and students.
The research flow consists of several sequential steps, as shown in Figure 1.

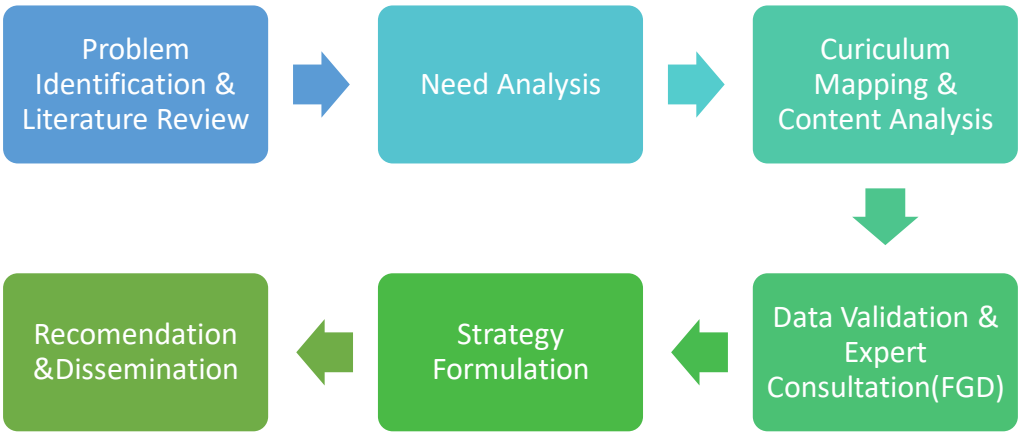

Figure 1. Research Flow of Vocational Education Readiness in Preparing Green Jobs

1. Problem Identification and Literature Review: Review of global and national frameworks related to green jobs, sustainable education, and vocational curriculum design [8,9].
2. Needs Analysis: Conducted through interviews and surveys with lecturers, curriculum developers, and industry partners to identify competencies required for green employment.
3. Curriculum Mapping and Content Analysis: Examination of existing curriculum documents at Polibatam to assess the extent of sustainability integration in learning outcomes, course content, and teaching approaches [17].
4. Data Validation and Expert Consultation: Validation of findings through focus group discussions (FGDs) with academic experts, policymakers, and industry practitioners.
5. Strategy Formulation: Development of curriculum implementation strategies emphasizing sustainability-oriented learning outcomes, partnership with green industries, and lecturer capacity-building programs.
6. Recommendation and Dissemination: Preparation of policy recommendations and dissemination of findings to Polibatam's academic stakeholders and the Directorate General of Vocational Education.

2.2 Data Collection Techniques

Data were obtained through several instruments:

a. Document Analysis: Review of Polibatam curriculum, course syllabi, and policy documents.
b. Questionnaires: Distributed to lecturers, students, and industry representatives to assess perceptions of curriculum readiness.
c. Interviews and FGDs: Conducted with key informants to validate and deepen understanding of identified needs.

2.3 Data Analysis

a. Qualitative Data were analyzed using thematic analysis to identify key issues and emerging patterns related to green job readiness and curriculum alignment.
b. Quantitative survey data were analyzed using descriptive statistics to describe respondents' perceptions and identify priority areas for improvement.
c. The final synthesis integrated both qualitative and quantitative findings to propose comprehensive curriculum development strategies.

3. RESULTS AND DISCUSSION

3.1 Research Findings

The findings of this study reveal that vocational education readiness for preparing graduates for green jobs in polytechnic settings, particularly at Batam State Polytechnic (Polibatam), is still at an emerging stage**.** The readiness levels vary across curriculum components, instructional design, and institutional policies. A Focus Group Discussion (FGD) involving six respondents, comprising program heads, lecturers, and a green jobs expert, was conducted to validate and refine the questionnaire findings. The results are

categorized into four major dimensions: (1) Vision and Mission, (2) Curriculum Structure and Content, (3) Teaching Methods and Resources, and (4) Industry and Policy Linkages.

3.2 Vision and Mission Alignment

Out of six respondents, five indicated that their program's vision and mission do not yet explicitly include sustainability or green economy principles. Only one respondent reported that green orientation is integrated into their study program's vision. This suggests that awareness at the foundational policy level remains low. Such findings are consistent with the early phase of institutional transformation described by, where organizational awareness precedes structural and cultural integration. A strong vision and mission emphasizing sustainability would serve as a strategic anchor for downstream curriculum innovation and institutional policy alignment.

3.3 Learning Outcomes and Graduate Profiles

Regarding learning outcomes**,** two respondents confirmed that green skills have been well-integrated, while two others stated they have not yet been addressed. This indicates inconsistency in implementation across programs [18].

For graduate projections**,** three respondents noted that graduates have not been oriented toward green industry sectors, while three others reported that their graduates are fairly or very well aligned with such sectors. This mixed result demonstrates that while some programs have begun to move toward sustainability-linked employability, others remain focused on conventional industrial needs.

These trends support the argument that curricular readiness is uneven, echoing findings by Putra et al. [19] that many TVET institutions are in the early stages of adopting green education frameworks.

3.4 Curriculum Structure and Content

Regarding curriculum materials, two respondents stated that there are no specific courses dedicated to green technology, while two mentioned that such courses already exist. This suggests that dedicated green technology modules remain rare and are often introduced as elective or supplementary topics [20].

Three respondents agreed that integrating green concepts across courses is fairly good, though only one rated it "very good." This suggests that environmental principles are often inserted contextually rather than systematically embedded in course design. Regarding learning materials and case studies**,** only one respondent said that the materials include up-to-date green economy issues very well. Similarly, only a few respondents (three out of six) reported global references and case studies, indicating a need to modernize teaching resources**.**

3.5 Teaching Methods and Learning Resources

The analysis of teaching methods shows that only one respondent believed that practicum activities already apply eco-friendly practices, while three stated that such

practices are not yet present. Problem-Based Learning (PBL) projects related to sustainability issues are also in the initial development stage [21].

Human resource capacity is another crucial aspect. Three out of six respondents noted that lecturers have not yet received green skills training, and only one reported excellent capacity. As Becker [12] highlights, human capital formation is central to institutional transformation; without adequately trained instructors, the integration of sustainability concepts remains limited.

Infrastructure and facilities scored the lowest readiness. Only one respondent stated that laboratory facilities already implement eco-friendly principles, while three others said that such initiatives are just beginning. This implies that infrastructure investment and green facility standards are essential prerequisites for successful curriculum implementation.

3.6 Industry and Policy Linkages

One of the most positive findings relates to industry involvement. Only one respondent mentioned the absence of industry participation in curriculum design, while three indicated a fair level of collaboration. This demonstrates that an emerging synergy is emerging between vocational institutions and green industry players.

Similarly, three respondents confirmed that their curriculum is already aligned with national policies such as the *RPJMN* (National Medium-Term Development Plan) and *SDGs*. This alignment reflects an increasing institutional awareness of the need to integrate national and global sustainability agendas into vocational education frameworks [22].

3.7 Synthesis of Findings and Strategy Prototype

The overall results indicate that vocational curriculum readiness for green jobs is still at an early stage. Although certain initiatives exist, such as industry partnerships and policy alignment, there remains significant room for improvement, particularly in curriculum content, faculty capacity, and green infrastructure [23].

Following the FGD with experts on green jobs and sustainable vocational education, a strategic prototype model was developed to guide curriculum reform and implementation (see Figure 2).

Figure 2. Prototype Model for Green Curriculum Integration in Polytechnic Education

1. Institutional Level (Vision and Policy)
   a. Revise institutional vision and mission statements to include sustainability and green economy objectives explicitly.
   b. Establish a "Green Campus Task Force" responsible for aligning educational, operational, and research activities with sustainability goals.
2. Curricular Level (Program Design and Learning Outcomes)
   a. Embed *green competencies* (resource efficiency, waste management, energy literacy) in program learning outcomes.
   b. Develop *core and elective green courses* that integrate environmental, social, and economic dimensions.
3. Instructional Level (Teaching and Learning Process)
   a. Apply *Project-Based Learning (PBL)* and *Problem-Based Learning (PBL)* approaches using real cases from local green industries.
   b. Provide capacity-building programs for lecturers in sustainability pedagogy and green technology applications.
4. Collaborative Level (Industry and Community Engagement)
   a. Strengthen partnerships with green industries for internships, apprenticeships, and joint research.
   b. Integrate *Community-Based Learning* to expose students to real sustainability challenges in their local environment.

This prototype aligns with international frameworks [13] that emphasize a whole-institution approach to greening TVET systems, combining curriculum, pedagogy, governance, and partnership dimensions.

The findings reinforce earlier research by Vakaliuk et al. [14], which concluded that Indonesian vocational curricula remain partially aligned with sustainability targets.

Compared to other polytechnics in Southeast Asia, Polibatam demonstrates moderate readiness, especially in industry collaboration, but lags in infrastructure and faculty training.

The mixed results also mirror the transitional characteristics described by the *Sustainability Transition Framework* [15], where early institutional innovations coexist with traditional practices. This transitional phase offers both challenges and opportunities, particularly for policy reform and curriculum redesign. In summary, while Polibatam and similar institutions show promising initiatives toward green jobs readiness, a systemic strategy integrating curriculum, human resources, infrastructure, and external partnerships is essential to achieve a holistic transformation.

DISCUSSION

The findings of this study indicate that vocational education readiness for green jobs remains at an emerging stage. The identified gaps across institutional orientation, curriculum structure, instructional practices, lecturer competencies, and infrastructure suggest that sustainability integration is still fragmented rather than systemic. These results align with Adjei et al. [22], which emphasizes that many Technical and Vocational Education and Training (TVET) institutions worldwide face similar challenges in holistically embedding sustainability principles.

One of the most significant findings concerns the limited integration of sustainability within institutional vision and mission statements. This condition reflects a foundational issue, as institutional direction plays a critical role in shaping curriculum priorities and pedagogical strategies. From the perspective of the Sustainability Transition Framework, systemic transformation requires alignment at multiple levels, including policy, organizational culture, and operational practices [24]. The absence of sustainability orientation at the institutional level may explain the inconsistent curriculum implementation observed in this study.

The uneven integration of green skills within learning outcomes further highlights structural challenges in curriculum design. While some respondents reported partial integration, the lack of uniformity suggests that sustainability concepts are often treated as supplementary rather than core competencies. This finding is consistent with the OECD (2023), which notes that green skills development frequently suffers from curricular compartmentalization, in which sustainability topics are isolated rather than embedded across disciplines. Such fragmentation may limit students' ability to develop interdisciplinary competencies essential for green jobs.

Another critical issue relates to teaching and learning practices. The limited application of eco-friendly practicum and green-focused Project-Based Learning (PjBL) indicates that sustainability principles have not yet been fully operationalized in instructional activities. Previous studies emphasize that experiential learning approaches are central to the acquisition of green skills[12]. The discrepancy observed in this study suggests that pedagogical innovation remains constrained by institutional, resource, and competency-related factors.

Lecturer competencies emerged as a major barrier to curriculum readiness. The limited participation in green skills training suggests that capacity-building efforts have not

kept pace with evolving workforce demands. Human Capital Theory [11] provides a useful lens for interpreting this finding, as educational quality is closely linked to instructors' competencies. Without adequate professional development, lecturers may struggle to integrate sustainability concepts effectively, thereby affecting curriculum delivery and student learning outcomes.

Infrastructure limitations further compound these challenges. The low adoption of eco-friendly laboratory practices indicates that sustainability transformation requires not only curriculum reform but also institutional investment. Similar constraints have been reported in developing vocational education contexts, where resource availability significantly influences green curriculum implementation, UNESCO-UNEVOC [24,25]. This finding underscores the interdependence between physical learning environments and sustainability-oriented education.

Despite these challenges, the study also identified positive trends. The relatively strong alignment with industry collaboration and national policy frameworks suggests that external drivers may support institutional transformation. Industry engagement has been widely recognized as a key enabler of green skills development [10]. The findings imply that vocational institutions may leverage existing partnerships to accelerate curriculum adaptation and enhance graduate employability in green sectors.

Importantly, the Focus Group Discussions (FGDs) with green job experts contributed to the development of a prototype model for integrating green curriculum. This prototype emphasizes multi-level alignment, including institutional policy orientation, curriculum redesign [15], pedagogical innovation, lecturer capacity development, and industry collaboration, unlike previous studies that primarily focus on pedagogical strategies or competency frameworks. This research proposes a systemic readiness model grounded in empirical needs analysis. This represents the study's primary contribution.

Overall, the findings suggest that interconnected institutional, structural, pedagogical, and resource-related factors influence curriculum readiness for green jobs. The study reinforces the argument that sustainability integration within vocational education must move beyond isolated curricular adjustments toward comprehensive systemic transformation.

4. CONCLUSION

This study highlights that vocational education readiness for green jobs remains at a developmental stage, characterized by partial and uneven integration of sustainability principles. The analysis indicates that interconnected institutional, structural, pedagogical, and resource-related factors influence the transformation of the curriculum toward green job preparation. The findings suggest that sustainability integration requires systemic alignment rather than isolated curriculum modifications.

The research contributes to the understanding that institutional orientation plays a foundational role in shaping curriculum direction. Without a clear sustainability positioning at the institutional level, curriculum implementation tends to be fragmented. Furthermore, the study emphasizes that green skills development is not solely a curriculum design issue but also involves lecturer competencies, instructional strategies, and infrastructure readiness.

From a practical perspective, the study provides implications for vocational education institutions, particularly polytechnics. Curriculum reform initiatives should adopt a holistic approach that encompasses institutional policy alignment, structured integration of green skills, pedagogical innovation, and capacity building for lecturers. Strengthening collaboration with industry and aligning educational practices with sustainability-driven labor market demands are also critical.

This research is subject to certain boundaries. The study focuses on a single vocational education institution, which may limit the generalizability of findings across diverse institutional contexts. Additionally, the readiness assessment primarily relies on stakeholder perceptions and curriculum analysis, without measuring long-term graduate outcomes.

Future research may extend this study by examining multiple vocational institutions to develop comparative insights into the implementation of green curricula. Further investigations could also evaluate the effectiveness of green curriculum prototypes, measure graduate employability in green sectors, and explore digital-based learning innovations supporting sustainability competencies.

Overall, this study contributes to the broader discourse on sustainability-oriented vocational education by proposing a systemic perspective on curriculum readiness. The findings offer practical guidance for educational institutions, policymakers, and curriculum developers in supporting workforce preparation for emerging green economic sectors. For the general public, this research underscores the critical role of vocational education in addressing environmental challenges through human resource development.

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REFERENCES

[1] M. Nuramalia Handayani, M. Ali, and D. Wahyudin, "Green Skills Understanding of Agricultural Vocational School Teachers around West Java Indonesia," *Indonesian Journal of Science & Technology*, vol. 5, no. 1, pp. 20–29, 2020, doi: 10.17509/ijost.v5i1/22897.

[2] M. Bone◊, E. Ehlinger, and F. Stephany, "Skills or Degree? The Rise of Skill-Based Hiring for AI and Green Jobs*," 2024.

[3] I. W. A. G. A. Muh Abdul Latif, "View of Expert Validation of the Green Competencies Model_ Strengthening Sustainable Vocational Education," *Journal of Vocational Education Studies*, vol. 8, no. 1, pp. 1–21, 2025.

[4] R. Riswano and I. Widiaty, "Identification of Competencies for Green Jobs in Tourism Skills at TVET: A Systematic Literature Review," *Journal of Vocational Education Studies*, vol. 6, no. 2, pp. 198–213, Nov. 2023, doi: 10.12928/joves.v6i2.8182.

[5] S. McGrath and J.-A. Russon, "TVET SI: Towards Sustainable Vocational Education and Training: Thinking beyond the formal," *Southern African Journal of Environmental Education*, vol. 39, May 2023, doi: 10.4314/sajee.v39.03.

[6] N. Ismail, S. I. S. Syed-Abdullah, T. Sulaiman, and M. H. Mohd Puad, "The Integration of Green Technology Elements in the Curriculum of Industrial Training at Malaysian Vocational Colleges," *International Journal of Education*, vol. 17, no. 2, p. 89, Aug. 2025, doi: 10.5296/ije.v17i2.22708.

[7] D. Vitalocca, A. Suherman, D. Rohendi, C. Yulia, and A. G. Abdullah, "Integrating computational thinking and green skills in vocational education through the bridging learning green informatics framework," *Discover Education*, Jan. 2026, doi: 10.1007/s44217-025-01095-0.

[8] C. C. Chinedu, A. Saleem, and W. H. N. Wan Muda, "Teaching and Learning Approaches: Curriculum Framework for Sustainability Literacy for Technical and Vocational Teacher Training Programmes in Malaysia," *Sustainability (Switzerland)*, vol. 15, no. 3, Feb. 2023, doi: 10.3390/su15032543.

[9] M. N. Fitriyanto, Diplan, and A. Pribadi, "Green skills in vocational learning through the project citizen model," in *Journal of Physics: Conference Series*, IOP Publishing Ltd, Mar. 2021. doi: 10.1088/1742-6596/1833/1/012048.

[10] A. A. Haloho, Pardjono, I. N. Saputro, Suyitno, and B. Ariwibowo, "Implementation of Green Skills in Vocational Education: Perceptions about Students' and Teachers' Behavioral Activities," *Jurnal Pendidikan dan Pengajaran*, vol. 56, no. 1, pp. 65–79, Apr. 2023, doi: 10.23887/jpp.v56i1.57990.

[11] R. M. Chola and H. Kiplagat, "The Contribution of TVET to Sustainable Development," *Africa Journal of Technical and Vocational Education and Training*, vol. 10, no. 1, pp. 58–63, May 2025, doi: 10.69641/afritvet.2025.101178.

[12] T. Suhendra, L. Subagiyo, and A. Basir, "Development of a Guidebook for Green Skills Implementation in Vocational Schools to Support Green Economy Transformation," *Edunesia : Jurnal Ilmiah Pendidikan*, vol. 6, no. 2, pp. 678–693, Mar. 2025, doi: 10.51276/edu.v6i2.1151.

[13] M. N. Fitriyanto, W. Wagiran, F. Zannah, D. Novian, and H. Mansur, "A Bibliometric Analysis of Green Skills Research in Vocational Education: 2018-2022," *Elinvo (Electronics, Informatics, and Vocational Education)*, vol. 9, no. 1, pp. 178–186, Nov. 2024, doi: 10.21831/elinvo.v9i1.71890.

[14] T. Vakaliuk, D. Antoniuk, A. Morozov, M. Medvedieva, and M. Medvediev, "Green IT as a tool for design cloud-oriented sustainable learning environment of a higher education institution," in *E3S Web of Conferences*, EDP Sciences, Apr. 2020. doi: 10.1051/e3sconf/202016610013.

[15] R. S. P. Fauziah *et al.*, "PROMOTING ISLAMIC VALUE FOR GREEN SKILL DEVELOPMENT IN ISLAMIC VOCATIONAL HIGH SCHOOL," *Jurnal Pendidikan Islam*, vol. 10, no. 1, pp. 53–64, 2024, doi: 10.15575/jpi.v10i1.35383.

[16] M. Fuchs, "Green Skills for Sustainability Transitions," Oct. 01, 2024, *John Wiley and Sons Inc*. doi: 10.1111/gec3.70003.

[17] H. Li, S. I. Khattak, X. Lu, and A. Khan, "Greening the Way Forward: A Qualitative Assessment of Green Technology Integration and Prospects in a Chinese Technical and Vocational Institute," *Sustainability (Switzerland)*, vol. 15, no. 6, Mar. 2023, doi: 10.3390/su15065187.

[18] S. A. Jayaprakash, "Greening TVET for Sustainable Development: A Path to a More Sustainable Future," *International Journal of Academic Research in Progressive Education and Development*, vol. 13, no. 1, Feb. 2024, doi: 10.6007/ijarped/v13-i1/20877.

[19] R. C. Putra, A. Dwi, P. Janata, I. M. Dongoran, and F. Thomas, "INTEGRATING TEACHING FACTORY AND GREEN TVET FOR GREEN SKILLS DEVELOPMENT: A SYSTEMATIC REVIEW This study aims to analyze the integration of teaching factory model with Green Technical and Vocational Education and Training for Green skills development through systematic literature review. The research employed systematic literature review using Preferred Reporting Items for Systematic Reviews and Meta-Analyses approach," 2025.

[20] A. Adjei, B. Mulyanti, A. G. Abdullah, B. C. Ampimah, and P. O.- Bonsu, "Exploring Approaches in Green Technical and Vocational Education Training (TVET): A Systematic and Bibliometric Review," *Journal of Vocational Education Studies*, vol. 7, no. 2, pp. 313–334, Nov. 2024, doi: 10.12928/joves.v7i2.10416.

[21] R. B. Mustapha, "Green and Sustainable Development for TVET in Asia," Bandung, Jul. 2015. [Online]. Available: http://invotec.fptk.upi.edu

[22] A. Adjei, B. Mulyanti, A. G. Abdullah, B. C. Ampimah, and P. O.- Bonsu, "Exploring Approaches in Green Technical and Vocational Education Training (TVET): A Systematic and Bibliometric Review," *Journal of Vocational Education Studies*, vol. 7, no. 2, pp. 313–334, Nov. 2024, doi: 10.12928/joves.v7i2.10416.

[23] F. ; Bassi and M. Guidolin, "Resource efficiency and Circular Economy in European SMEs: Investigating the role of green jobs and skills," 2019.