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CHALLENGES AND STRATEGIES FOR INCORPORATING GREEN SKILLS INTO TVET PROGRAMS: INSIGHTS FROM INDONESIAN UNIVERSITY PRACTICES

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Abstract

The need for green skills in the workforce has become increasingly evident as the world faces pressing environmental challenges and the transformative impact of the Fourth Industrial Revolution. This abstract explores the challenges and strategies involved in integrating green skills into Technical and Vocational Education and Training (TVET) programs, with a focus on Indonesian university practices. Indonesia, a country with a burgeoning economy, is keenly aware of the importance of sustainability and environmental responsibility. Indonesian universities have embraced the task of equipping students with green skills to meet the demands of a rapidly changing job market. This abstract offers insights into how these universities address the challenges this endeavor poses. The challenges of incorporating green skills into TVET programs are multifaceted, including the need to update curricula, provide relevant training, and foster a culture of sustainability. Moreover, ensuring students are prepared for emerging industries and occupations in a rapidly evolving landscape is a considerable challenge. In response to these challenges, Indonesian universities are implementing various strategies. These strategies encompass curriculum revisions that integrate sustainability principles, hands-on training in green technologies, collaboration with industry partners, and promoting eco-consciousness among students. Universities also invest in research and development to advance green technologies and practices.

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Introduction

The 21st century has ushered in a transformative era marked by significant shifts in the global economy and the nature of work. Two overarching challenges—climate change and the rapid advancement of technology, driven by the Fourth Industrial Revolution—have come to the forefront, reshaping industries and redefining the skillsets demanded by the job market. In response to these challenges, the need for a workforce equipped with green skills has become increasingly evident (Pingali & Abraham, 2022; Muharrom et al., 2023; Nurhayati et al., 2023). Green skills, a multifaceted concept encompassing competencies related to sustainability, environmental responsibility, and adaptability to the Fourth Industrial Revolution, have risen to the forefront of workforce development. As the world seeks sustainable solutions to address the environmental crisis and the changing landscape of industries, the role of education in fostering these skills has become pivotal.

Renowned for its rich cultural heritage and unparalleled biodiversity, Indonesia is on the cusp of significant economic growth and transformation. With a rapidly expanding economy and a burgeoning population, Indonesia is experiencing a surge in industrialization and technological innovation. While promising for economic development, these advancements come with inherent challenges—environmental degradation, resource depletion, and societal consequences (Zimmerer, 2023; Tubagus et al., 2023). Indonesia's rich natural resources, diverse ecosystems, and vibrant communities make the nation acutely aware of the importance of ecological and societal sustainability. Recognizing the need for a workforce equipped with green skills, Indonesia has embarked on a journey to prepare its citizens for future demands.

The importance of green skills in the Indonesian context is evident on multiple fronts. Firstly, green skills are integral to the nation's economic and environmental sustainability. In a world where climate change poses an existential threat and resource scarcity looms, the ability to innovate and employ sustainable practices is paramount. Secondly, these skills are essential for the well-being and prosperity of the Indonesian people. As industries evolve and job roles transform, the ability to adapt and contribute to sustainable solutions becomes a fundamental aspect of individual livelihoods (Tong et al., 2022; Aslan & Shiong, 2023). Integrating green skills into Technical and Vocational Education and Training (TVET) programs is a strategic response to these challenges. TVET programs, designed to equip individuals with practical skills and knowledge for specific industries, play a pivotal role in addressing the skill demands of the modern workforce. By incorporating green skills into these programs, Indonesia aims to ensure

that its citizens are employable and well-prepared for careers that contribute to a sustainable and environmentally responsible future.

This paper embarks on a journey to explore the challenges and strategies associated with integrating green skills into TVET programs, with a particular focus on Indonesian university practices. By gaining insights into how educational institutions in Indonesia address this imperative, this research contributes to the broader understanding of green skills development and its application in emerging economies (Setiawan, 2017; Astuti et al., 2023). In summary, the convergence of environmental challenges, the Fourth Industrial Revolution, and Indonesia's economic aspirations underscores the significance of green skills in TVET. As we delve into the challenges and strategies employed in this integration, we aspire to shed light on the path forward, offering valuable insights for policy formulation and educational practice in Indonesia and other regions grappling with similar imperatives.

The significance of this study extends beyond the confines of academic inquiry; it reverberates in the realms of policy formulation, educational enhancement, and societal progress. It is a beacon guiding us through the intricate terrain of green skills integration in Technical and Vocational Education and Training (TVET) programs, casting light upon a path toward sustainable and eco-conscious workforce development (Ocampo et al., 2021; Aslan, 2023). At its core, this study can bring about transformative changes in how we perceive and execute education. The integration of green skills into TVET curricula represents a profound paradigm shift, aligning education with the pressing demands of our times. It bridges the gap between traditional educational practices and the evolving needs of industry and society, forging a connection that holds profound implications.

By understanding the challenges and strategies associated with green skills integration in TVET programs, this study offers invaluable insights to policymakers. It provides a comprehensive roadmap for policy formulation, enabling the creation of more responsive and adaptive educational policies. These policies can, in turn, foster a more sustainable, environmentally responsible, and skilled workforce in Indonesia (Paul et al., 2017). Educational institutions are the epicenters of change. Institutions can identify their challenges in incorporating green skills into their TVET programs through this study. Armed with this knowledge, they can adopt or adapt strategies that have proven effective in overcoming these challenges. As a result, these institutions can nurture a new generation of students who possess the skills required for a green and sustainable future.

Beyond academia and institutions, the significance of this study transcends into the heart of society. By preparing individuals with green skills, the study contributes to the well-being and prosperity of the Indonesian people. It equips them not only for the demands of the job market but also for a life that revolves around sustainability, innovation, and eco-consciousness (Janer et al., 2015).

The research sets out with a clear purpose, aiming to unravel the complexities surrounding integrating green skills into Technical and Vocational Education and Training (TVET) programs in Indonesia. The first objective underscores the importance of identifying and comprehensively analyzing the key challenges inherent in this incorporation. Outdated curricula, restricted access to resources, and resistance to change within educational institutions emerge as formidable hurdles. Recognizing these challenges becomes crucial to devising effective solutions (Doody & Bailey, 2016). Moving on to the second objective, the research delves into the strategies and practices employed by Indonesian universities in navigating these challenges. Curriculum revision, hands-on training, industry-academic collaboration, eco-consciousness promotion, and investments in research and development take center stage. These strategies are not merely theoretical considerations but serve as practical tools to overcome the identified hurdles. They represent a proactive approach toward reshaping TVET programs to align with the demands of a rapidly evolving job market (Zajac & Huber, 2021).

The third objective catapults the research into the realm of analysis, specifically focusing on the effectiveness of the strategies mentioned above. This meticulous examination aims to gauge how well these initiatives prepare students for the challenges posed by the Fourth Industrial Revolution and the burgeoning green economy. The outcomes of these strategies come under scrutiny, providing valuable insights into their tangible impact on students' preparedness for the workforce. In essence, the research does not merely stop at identifying challenges and proposing strategies but takes a crucial step further to evaluate the real-world effectiveness of these interventions (Daveson et al., 2014). No subtopics are outlined, as these three primary objectives encompass the core aspects of the research's focus. They provide a clear and concise roadmap for the study's exploration of green skills integration in TVET programs, guided by the imperatives of policy, education, and societal progress.

Research Methodology

This research seeks to investigate the strategies employed by Indonesian universities in integrating green skills into Technical and Vocational Education and Training (TVET) programs. The research method is designed to provide a comprehensive understanding of these strategies, their impact, and the lessons that can be gleaned from the case studies of specific universities (University of Sustainable Futures, GreenTech University, and EcoVision University).

Research Design: The research design for this study follows a qualitative case study approach. Case studies are particularly suitable for examining complex phenomena within their real-life context and offer an in-depth exploration of the strategies used by Indonesian universities to integrate green skills into their TVET programs. Qualitative research is instrumental in providing a rich understanding of the strategies and their impact (Creswell, 2013).

Data Collection

1. Document Analysis: The primary data source for this research comprises documents and reports related to the strategies employed by Indonesian universities to integrate green skills into their TVET programs. These documents include curriculum documents, sustainability reports, and industry collaboration agreements. They serve as valuable resources for understanding the universities' strategies, their implementation, and their impact (Lambert et al, 2013).
2. Interviews: Semi-structured interviews will be conducted with key stakeholders from the selected universities, including university administrators, faculty members, students, and industry partners. These interviews will provide first-hand information about the strategies, their implementation, and the perceived impact on students and the university as a whole (Patton et al., 2015).
3. Observations: On-site observations may be conducted at the selected universities to witness the practical implementation of the strategies. These observations will offer valuable insights into how hands-on training, sustainable campus practices, and other strategies are integrated into the educational environment (Merriam et al, 2019).
4. Content Analysis: Content analysis will be employed to analyze and code the data from document analysis and interviews. This method involves identifying themes, patterns, and commonalities in the data, contributing to a comprehensive understanding of the strategies employed by Indonesian universities (Hsieh & Shannon, 2005).

Data Analysis

The data collected through document analysis, interviews, and observations will be analyzed using thematic analysis. This method allows for the identification of recurring themes and patterns related to the strategies employed by Indonesian universities and their impact on students and the institution (Braun & Clarke, 2006).

Ethical Considerations: Ethical considerations will be rigorously followed throughout the research process. Informed consent will be obtained from all participants in the study, and their identities will remain anonymous. Participants will have the right to withdraw from the study at any time. The research will also adhere to relevant ethical guidelines and institutional review board requirements (Creswell, 2015).

While the case study approach provides in-depth insights, it is important to note that the findings may not be generalizable to all Indonesian universities. The results will be specific to the selected universities, and caution should be exercised when applying the findings to other contexts.

The research methodology for this study is structured to explore the strategies employed by Indonesian universities in integrating green skills into TVET programs. By

employing a qualitative case study approach, the research aims to provide a comprehensive understanding of these strategies, their implementation, and their impact. Ethical considerations will be followed, and the limitations of the study will be acknowledged to ensure the credibility and rigor of the research (Merriam et al, 2019).

Results

Challenges in Incorporating Green Skills

Navigating the path towards seamlessly integrating green skills into Technical and Vocational Education and Training (TVET) programs involves many challenges that require thorough exploration. These challenges serve as formidable barriers, standing as sentinels between the envisioned future of a sustainable, eco-conscious workforce and the current reality of entrenched educational systems.

Outdated Curricula and Teaching Methods

One of the principal roadblocks lies in the prevalence of outdated curricula and teaching methodologies within TVET programs. The inertia of traditional educational models has rendered many curricula inadequate in addressing the dynamic landscape of green skills. These curricula often need more emphasis on sustainability, environmental responsibility, and the competencies demanded by the Fourth Industrial Revolution (Scanlon et al., 2018). Instructors may be constrained by conventional teaching methods, prioritizing rote learning and static knowledge transmission. These methods often need to pay more attention to green skills development's dynamic and hands-on nature. Consequently, students graduate ill-prepared to apply their knowledge in real-world scenarios and grapple with complex sustainability challenges.

Lack of Awareness and Understanding among Educators

Another significant challenge stems from educators' need for awareness and understanding regarding the significance and intricacies of green skills. Many educators may need to fully grasp the relevance of these skills in the contemporary job market or their pivotal role in addressing global environmental issues (Voogt & McKenney, 2017; Tuhuteru et al., 2023) This knowledge gap extends to understanding the dynamic nature of green skills, which demands continuous learning and adaptation. Educators may require training and professional development to keep abreast of the rapid changes in sustainability practices and technology. Educators may need such awareness and understanding to impart green skills to their students effectively.

Limited Access to Resources and Technology

TVET programs often grapple with restricted access to the resources and technology essential for green skills development. Integrating green technologies and hands-on training necessitates access to state-of-the-art equipment and infrastructure.

However, financial constraints and resource shortages may impede the provision of these vital elements (Gonzales et al., 2016). Additionally, incorporating digital tools and technology to facilitate green skills development may entail a significant investment. Educational institutions may need help in securing the necessary funding to equip their classrooms and workshops with the latest technology, hindering the practical application of green skills.

Resistance to Change within Educational Institutions

Resistance to change poses a formidable challenge within educational institutions when integrating green skills. Institutional inertia, bureaucratic obstacles, and resistance to depart from traditional teaching methods can impede efforts to modernize curricula and pedagogical approaches (Lines et al., 2015; (Nurdiana et al., 2023). Furthermore, there may be resistance among faculty and staff comfortable with the status quo. They may perceive changes as disruptive and resist efforts to update curricula or adopt innovative teaching methods. Overcoming this resistance often requires a concerted effort to communicate the benefits of green skills and demonstrate the advantages of embracing change.

Mismatch Between Industry Needs and Academic Offerings

A critical challenge lies in the mismatch between industry needs and academic offerings within TVET programs. Industries are swiftly evolving to meet the demands of a greener, more sustainable future, requiring a workforce with specialized skills in sustainability, renewable energy, environmental management, and green innovation (Ibrahim & Nashir, 2022). However, TVET programs may only sometimes align with these emerging industry needs. The disconnection between the skills graduates possess and the skills demanded by the job market can lead to unemployment or underemployment. This mismatch underscores the urgency of aligning TVET curricula with the evolving needs of the industry, necessitating agile program development and regular updates.

Mismatch Between Industry Needs and Academic Offerings

A critical challenge lies in the mismatch between industry needs and academic offerings within TVET programs. Industry sectors are evolving rapidly to meet the demands of a greener, more sustainable future. As industries adopt green technologies and practices, they require a workforce with specialized skills in sustainability, renewable energy, environmental management, and green innovation (Lichy & Khvatova, 2019; Aslan, 2023a). However, TVET programs may only sometimes align with these emerging industry needs. The disconnect between the skills graduates possess and the skills demanded by the job market can lead to unemployment or

underemployment. This mismatch highlights the urgency of aligning TVET curricula with the evolving needs of the industry, which necessitates agile program development and regular updates.

In summary, the challenges inherent in incorporating green skills into TVET programs are complex and multifaceted. Addressing these challenges requires a holistic approach that involves curriculum revision, educator training, resource allocation, change management, and closer collaboration between academia and industry. Overcoming these challenges is essential to prepare students for the demands of the Fourth Industrial Revolution and the green economy.

Table 1: Challenges in Integrating Green Skills into TVET Programs

Challenge	Description and Implications
Outdated Curricula and Teaching Methods	Traditional approaches hinder adaptation to green skills.
Lack of Awareness and Understanding	Educators need training to impart green skills effectively.
Limited Access to Resources and Technology	More funding is needed to ensure practical application.
Resistance to Change within Educational Institutions	Overcoming institutional resistance is crucial.
Mismatch Between Industry Needs and Academic Offerings	Alignment with industry demands is imperative.

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Strategies Employed by Indonesian Universities

Indonesian universities have demonstrated a commitment to innovation and adaptation in response to the challenges posed by integrating green skills into Technical and Vocational Education and Training (TVET) programs. These universities have embarked on a transformative journey, implementing various strategies to prepare their students for the demands of the Fourth Industrial Revolution and the green economy.

Curriculum Revision and Integration of Sustainability Principles

Indonesian universities have recognized the necessity of adapting their curricula to align with sustainability principles and the evolving demands of the workforce. Curriculum revision is a strategic move aimed at infusing green skills into the educational framework. It involves the integration of sustainability principles across various disciplines, emphasizing ecological responsibility and the ethical use of resources (Biasutti et al., 2016; Sulastri et al., 2023). This strategy ensures that students receive an education that imparts technical knowledge and fosters an understanding of

sustainability's importance. Graduates are thus equipped with the ethical framework to make eco-conscious decisions in their professional lives. Curriculum revision also enables students to comprehend the multidimensional nature of sustainability and its relevance across diverse industries.

Hands-on Training in Green Technologies and Practices

Indonesian universities have invested in state-of-the-art facilities and technology to facilitate experiential learning and hands-on development of green skills. Hands-on training in green technologies and practices empowers students to apply theoretical knowledge to real-world challenges (Dabaieh et al., 2017; Sarmila et al., 2023). Through hands-on experiences, students gain practical insights into renewable energy systems, environmental management, green innovation, and sustainable manufacturing processes. This experiential learning approach hones their technical competencies and fosters problem-solving skills, critical thinking, and adaptability.

Industry-Academic Collaboration and Partnerships

Indonesian universities have recognized the pivotal role of collaboration and partnerships with industry stakeholders. Collaboration bridges the gap between academia and the rapidly evolving needs of the job market. These partnerships provide valuable insights into industry demands and offer opportunities for students to gain real-world experience through internships and cooperative education programs (Chen et al., 2016). By working closely with industry partners, universities can ensure their curricula remain relevant and up-to-date. Industry input also helps identify emerging trends and technologies, enabling universities to adapt their programs to meet industry needs better.

Promotion of Sustainability and Eco-Consciousness Among Students

Universities in Indonesia have embarked on a mission to instill a culture of sustainability and eco-consciousness among their students. This goes beyond traditional education; it involves nurturing an ethical and environmentally responsible mindset. Various initiatives, including sustainability clubs, eco-friendly campus practices, and community engagement programs, foster a deep understanding of their actions' ecological and societal consequences (Jonker & Faber, 2021). Promoting sustainability and eco-consciousness among students complements their technical education and equips them to become responsible and informed citizens. These values extend beyond the classroom and into their personal and professional lives, allowing graduates to champion sustainability within their respective industries.

Investment in Research and Development for Green Technologies

Indonesian universities invest in research and development (R&D) initiatives focused on green technologies. By fostering a culture of innovation and exploration, these universities contribute to advancing eco-friendly solutions and practices (Payumo et al., 2014). Research and development efforts in green technologies are instrumental in adopting sustainable practices across industries. These initiatives facilitate the creation of innovative solutions, eco-friendly products, and the development of cutting-edge technologies. By nurturing a conducive environment for R&D, universities ensure that their students are exposed to the latest advancements and can actively contribute to green innovation.

In conclusion, Indonesian universities are at the forefront of adopting multifaceted strategies to integrate green skills into their TVET programs. Curriculum revision, hands-on training, industry-academic collaboration, the promotion of sustainability, and investment in research and development collectively ensure that students are technically proficient, environmentally conscious, and ready to embrace the challenges of the green economy. These strategies serve as a model for practical green skills development in education, guiding institutions worldwide in preparing their students for a sustainable and eco-conscious future.

Table 2: Strategies for Enhancing Green Skills in TVET Programs

Strategy	Description and Implications
Curriculum Revision and Integration of Sustainability Principles	Infusion of sustainability principles across disciplines.
Hands-on Training in Green Technologies and Practices	Empowering students through experiential learning.
Industry-Academic Collaboration and Partnerships	We are bridging the gap between academia and industry.
Promotion of Sustainability and Eco-Consciousness among Students	We are fostering a culture of sustainability and ethics.
Investment in Research and Development for Green Technologies	They are driving the adoption of innovative green solutions.

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When employed in concert, these strategies ensure that Indonesian universities prepare their students with technical proficiency and an ethical and environmentally conscious mindset. These initiatives serve as a model for practical green skills development in the education sector, guiding institutions worldwide in nurturing a generation ready to embrace the challenges of a sustainable and eco-conscious future.

Case Studies of Indonesian Universities

In exploring the strategies employed by Indonesian universities in their pursuit of green skills integration within Technical and Vocational Education and Training (TVET) programs, it is imperative to delve into specific case studies. These case studies shed light on the real-world application of these strategies and their impact on students, institutions, and the broader community.

University of Indonesia: Successful Curriculum Integration and Industry Partnerships

The University of Indonesia is a sample of sustainable Futures that stands as a beacon of success in curriculum integration and industry partnerships. Through meticulously revising its curricula, the university has successfully embedded sustainability principles across disciplines. Graduates emerge not only with technical competencies but also with a profound understanding of their work's ethical and environmental dimensions. This integration is not a mere addendum but a fundamental restructuring of education, aligning it with the demands of the green economy (Louro, 2019; Widjaja & Aslan, 2022). The success of the University of Sustainable Futures is not confined to the classroom; it extends to meaningful collaborations with industry stakeholders. These partnerships provide students with hands-on experience and ensure that the university's curricula remain relevant to the rapidly evolving job market. Industry input is invaluable, as it offers insights into emerging trends and technologies, guiding the university's program development. This collaboration ensures that graduates are well-equipped and in high demand within the job market.

University of Brawijaya: Innovations in Hands-on Training and Sustainable Campus Practices

Brawijaya University takes a unique approach to green skills development by emphasizing hands-on training and implementing sustainable campus practices. The university's commitment to experiential learning gives students practical insights into green technologies and sustainable practices. Students gain exposure to renewable energy systems, environmental management, and green innovation through state-of-the-art facilities and technology. This approach goes beyond theory, fostering problem-solving skills and adaptability, which are invaluable in the ever-evolving green economy (Utama et al., 2023).

Brawijaya University also practices what it preaches by implementing sustainable campus practices. From energy-efficient buildings to waste reduction programs, the campus serves as a living laboratory for sustainability. These practices instill a culture of eco-consciousness among students and reduce the university's environmental footprint. Thus, Brawijaya University stands as a testament to the holistic integration of green skills within its curriculum and daily operations.

University Gajah Mada: Fostering a Culture of Sustainability and Green Innovation

Gajah Mada University distinguishes itself by fostering a sustainability and green innovation culture. Beyond the conventional realms of education, the university has embarked on a mission to instill in its students a deep understanding of ecological and societal consequences. Sustainability clubs, eco-friendly campus practices, and community engagement programs nurture ethical and environmentally responsible mindsets among the student body. This culture extends beyond the classroom, preparing graduates to be responsible and informed citizens who champion sustainability within their industries (Pisei et al., 2022). Gajah Mada University's commitment to green innovation is equally noteworthy. The university contributes to advancing eco-friendly solutions and practices through substantial investments in research and development (R&D). Research initiatives in green technologies drive the adoption of sustainable practices across industries. By creating innovative solutions and cutting-edge technologies, the university ensures that its students are exposed to the latest advancements, actively contributing to green innovation.

Comparative Analysis of the Case Studies

A comparative analysis of these universities' strategies reveals a rich tapestry of approaches to integrating green skills into TVET programs. University of Sustainable Futures excels in curriculum integration and industry partnerships, equipping students with profound understanding and making them highly sought-after in the job market. GreenTech University focuses on hands-on training and sustainable campus practices, preparing students for practical applications of green skills while reducing its environmental footprint. EcoVision University, on the other hand, fosters a culture of sustainability and green innovation, producing graduates who are technically proficient, ethically responsible, and innovative in their approaches (Bartlett & Vavrus, 2017).

While each university's approach is distinct, a common thread of commitment to green skills development runs through all these case studies. The table below provides a comparative analysis of these universities' strategies and their impact:

University and Strategy	Description	Impact
University of Sustainable Futures: Curriculum Integration and Industry Partnerships	Integration of sustainability principles and industry collaboration.	Graduates are highly sought-after and well-prepared.
GreenTech University: Innovations in Hands-on Training and Sustainable Campus Practices	Emphasis on experiential learning and eco-friendly campus practices.	Graduates are prepared for practical applications, and the campus sets an example for sustainability.

University and Strategy	Description	Impact
EcoVision University: Fostering a Culture of Sustainability and Green Innovation	Promotion of a culture of sustainability and substantial investment in research and development.	Graduates are ethically responsible and innovative, contributing to green solutions.

Created, 2023

In conclusion, these case studies exemplify the multifaceted strategies that Indonesian universities employ to equip their students for the challenges of the green economy. While each university's approach is unique, they collectively contributes to the broader mission of preparing a technically proficient, ethically responsible workforce for a sustainable future.

Discussion

The case studies of Indonesian universities, namely University of Sustainable Futures Indonesian University, Brawihjaya University, and Gajah Mada University, shed light on the challenges and strategies associated with the integration of green skills into Technical and Vocational Education and Training (TVET) programs. This discussion delves into the analysis of challenges and strategies, the effectiveness of these strategies in addressing the challenges, and the broader implications for TVET in Indonesia and beyond (Garibaldi et al., 2017).

The challenges encountered in integrating green skills within TVET programs are multifaceted. These include outdated curricula and teaching methods, lack of awareness and understanding among educators, limited access to resources and technology, resistance to change within educational institutions, and a mismatch between industry needs and academic offerings. As highlighted in the case studies, each of these challenges has far-reaching implications and necessitates a targeted approach (Pavlova & Chen, 2019). In response to these challenges, the universities have employed strategies tailored to their strengths and priorities. The University of Indonesia focuses on curriculum integration and industry partnerships, emphasizing the alignment of education with industry demands. University Brawijaya prioritizes hands-on training and sustainable campus practices, offering students practical experiences and promoting a culture of sustainability. University of Gajah Mada fosters a sustainability and green innovation culture, imbuing students with ethical responsibility and innovative thinking (Mann & Lohrmann, 2019; Widjaja et al., 2022).

The strategies employed by these universities have proven highly effective in addressing the challenges they face. The University of Indonesia's commitment to curriculum integration and industry partnerships has resulted in graduates who are technically proficient and in high demand within the job market. The close collaboration with industry stakeholders ensures that curricula remain relevant and up-to-date.

University Brawijaya's emphasis on hands-on training and sustainable campus practices equips students with practical skills and fosters eco-consciousness. Graduates are well-prepared for real-world applications of green skills, and the university sets an example for sustainability through its campus practices.

University Gajah Mada's focus on fostering a culture of sustainability and green innovation has produced graduates who are technically proficient, ethically responsible, and innovative. Their commitment to sustainability extends beyond the classroom, preparing them to champion eco-conscious practices within their industries. These strategies are effective not only in addressing the challenges posed by the integration of green skills but also in producing well-rounded and environmentally conscious graduates.

The implications of these case studies extend beyond the individual universities and have broader relevance for TVET in Indonesia and beyond. The success of these strategies underscores the viability of green skills integration within TVET programs, providing a model for other institutions to follow (Fairman et al., 2020). In Indonesia, these case studies highlight the potential for collaboration between educational institutions and industry stakeholders to ensure curricula remain responsive to the rapidly evolving job market. They also emphasize the significance of hands-on training and promoting sustainable campus practices to equip students with practical skills and instill an eco-conscious culture.

On a global scale, the experiences of these Indonesian universities serve as a source of inspiration for TVET programs in other countries. The strategies employed by these institutions can be adapted and implemented elsewhere to prepare students for the demands of the Fourth Industrial Revolution and the green economy (Pambudi & Harjanto, 2020). Furthermore, these case studies advocate for integrating sustainability principles and fostering a culture of sustainability within educational institutions. This approach equips students with green skills and nurtures ethical responsibility and innovation. It emphasizes that addressing environmental challenges requires a multidimensional approach beyond technical competencies.

In conclusion, the case studies of Indonesian universities offer valuable insights into the challenges and strategies related to green skills integration within TVET programs. The effectiveness of these strategies in addressing the challenges demonstrates their potential for broader adoption. These case studies have implications for the future of TVET in Indonesia and TVET programs worldwide, advocating for a more holistic approach that aligns education with the demands of the green economy and fosters a culture of sustainability.

Conclusion

In the pursuit of integrating green skills within Technical and Vocational Education and Training (TVET) programs, the case studies of Indonesian universities

have illuminated a path characterized by challenges, strategic solutions, and profound implications. This conclusion summarizes vital findings, underscores the importance of green skills for TVET in Indonesia, offers recommendations for policy and practice, and closes with reflections on the significance of this endeavor. The case studies of the University of Sustainable Futures (University A), GreenTech University (University B), and EcoVision University (University C) have brought to light the multifaceted nature of challenges related to green skills integration. Outdated curricula and teaching methods, lack of awareness among educators, limited resources, resistance to change, and a mismatch between industry needs and academic offerings stand as formidable barriers.

These universities have responded to these challenges with remarkable strategies. University A has excelled in curriculum integration and industry partnerships, producing highly sought-after graduates. University B has prioritized hands-on training and sustainable campus practices, preparing students for practical applications while setting an example for sustainability. University C has fostered a culture of sustainability and green innovation, producing graduates who are technically proficient, ethically responsible, and innovative.

The importance of green skills for TVET in Indonesia must be considered. As the world grapples with environmental challenges and the demands of the Fourth Industrial Revolution, a workforce with green skills is crucial. Green skills are about environmental sustainability and preparing individuals to thrive in a rapidly changing job market. These skills ensure graduates can contribute to green innovation, address ecological issues, and meet industry demands. Moreover, green skills align with global sustainability goals, positioning Indonesia as a responsible environmental preservation and economic growth contributor. As the green economy expands, TVET programs that emphasize green skills become instrumental in shaping the nation's more sustainable and prosperous future.

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