Article

Integrating Green Finance into Vocational Education: Curriculum Design and Implementation Strategies for Sustainable Development

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ABSTRACT

Drawing on literature review, document analysis, and 18 semi-structured stakeholder interviews carried out at eight Taiwanese technological universities (January–March 2025), this study proposes a three-dimensional curriculum framework theoretical foundation, practical applications, and project-based learning for embedding green-finance competencies in vocational education. The qualitative evidence highlights four implementation strategies: faculty development, modular course design, deep industry partnerships, and authentic assessment. Findings underscore that aligning curricula with industry demand and sustainability mandates can bridge the current green skills gap in vocational education and enhance graduate employability in sustainable finance roles.

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INTRODUCTION

Green finance has emerged as a key focus in corporate governance in recent years, particularly about the Sustainable Development Goals (SDGs) and Environmental, Social, and Governance (ESG) frameworks. Organizations increasingly seek approaches that benefit society while enhancing their brand recognition through sustainable practices (Tolliver et al., 2020). From a definitional perspective, green finance emphasizes the implementation of sustainability concepts while fulfilling the vision of environmentally friendly financial systems. For the financial industry, analyzing social responsibilities and the interplay between commercial interests and environmental protection requires a sustainability-oriented approach.

Contemporary financial sectors have begun promoting various green financial products, attracting public engagement in sustainability initiatives through collaborative models involving individuals, corporations, and financial holding companies. These efforts aim to mitigate negative impacts of climate change through targeted interventions (Bolton et al., 2020). As a key driver in the transformation of the global financial system, the definition and scope of green finance continue to expand. Tolliver et al. (2020) note that green finance encompasses all financial instruments and services designed to promote environmental sustainability, including green credit, green bonds, green funds, and carbon trading mechanisms. These financial innovations not only provide funding for environmental projects but also reshape global capital flows. According to the Global Sustainable Investment Alliance (2022), global sustainable investment assets have exceeded $35.3 trillion, with an annual growth rate of 15%, indicating that green finance has evolved from a niche market to a mainstream investment domain.

The theoretical foundation of green finance is rooted in environmental economics and the theory of sustainable development. Schoenmaker and Schramade (2019) proposed the "sustainable finance triangle" model, emphasizing that financial decisions should simultaneously consider financial returns, environmental impacts, and social benefits. This model challenges traditional financial theory's binary focus on risk and return, providing financial institutions with a more comprehensive framework for decision-making. Campiglio (2016) analyzed the role of central banks and financial regulatory authorities in promoting low-carbon transitions from a macroeconomic perspective, highlighting how monetary policy and prudential regulation can serve as powerful tools for advancing the development of green finance.

The United Nations Environment Programme Finance Initiative (UNEP FI) and Principles for Responsible Investment (PRI) have established globally recognized sustainable finance frameworks, providing practical guidelines for financial institutions. The European Union's Sustainable Finance Action Plan has created the world's most comprehensive green finance regulatory system through

unified taxonomy standards, mandatory disclosure requirements, and low-carbon benchmarks. Research by Migliorelli (2021) demonstrates that these standardization efforts have significantly reduced market information asymmetry and enhanced the credibility and transparency of green finance products.

As one of the world's largest green bond markets, China promotes the development of green finance through a combination of policy guidance and market mechanisms. Wang and Zhi (2016) analyzed the implementation effects of China's green credit policies, particularly in climate risk modeling and ESG data analysis. Southeast Asian countries, such as Singapore and Malaysia, are actively developing Islamic Green Finance, which combines Islamic financial principles with environmental sustainability to create a unique market positioning.

Although Taiwan's development in green finance began relatively late, it has progressed rapidly in recent years, establishing a comprehensive policy framework. Research by Lin and Chiu (2022) found that Taiwan's green finance market still has room for improvement in terms of depth and breadth, particularly in green bond diversification, establishing a carbon trading mechanism, and standardizing ESG ratings.

Dorfleitner et al. (2023) noted that blockchain technology can significantly enhance the transparency and efficiency of carbon credit trading, allowing financial institutions to more accurately quantify the potential impact of climate change on investment portfolios. Research by Amel-Zadeh and Serafeim (2018) indicates the rise of "Quantitative ESG Investing." However, "greenwashing" issues have become increasingly severe, with actual environmental benefits difficult to verify. As Delmas and Burbano (2011) found in their research, this poses a challenge for financial institutions to assess long-term environmental risks accurately. Bolton et al. (2020) introduced the concept of "Green Swan," emphasizing the systemic and unpredictable nature of climate risk and its potential threat to financial stability.

In response to changing international circumstances, countries are committed to reducing the impacts of climate change by establishing medium and long-term carbon reduction targets. Through public-private partnerships, they encourage industry, government, academia, and research sectors to collectively consider how to ensure environmental sustainability across generations and integrate financial resources to guide enterprises toward carbon reduction transformation goals gradually. Similarly, frameworks such as SDGs and ESG aim to improve national sustainable development processes.

The evolution of the global climate governance framework provides the policy background for green finance. From the 1997 Kyoto Protocol to the 2015 Paris Agreement, international climate negotiations have gradually established mechanisms for sharing emission reduction responsibilities. Article 2.1(c) of the Paris Agreement, for the first time, incorporated "making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient

development" into global objectives, providing a clear policy signal for the development of green finance. Research by Monasterolo and de Angelis (2020) found that this reflected the impact of policy changes on market expectations. The 2021 Glasgow Climate Conference (COP26) further emphasized the central role of the financial system in climate transition, with the Glasgow Financial Alliance for Net Zero (GFANZ) committing to mobilize $130 trillion to support net-zero emission targets.

The unification of corporate sustainability reporting standards represents a significant recent development. The International Sustainability Standards Board (ISSB), established in 2021, aims to create globally unified sustainability disclosure standards that integrate existing frameworks, such as the Task Force on Climate-related Financial Disclosures (TCFD) and the Sustainability Accounting Standards Board (SASB). Research by Christensen et al. (2021) indicates that listed companies are required to gradually adopt the TCFD framework for disclosing climate-related information and plan to align with international standards.

This paper focuses on higher vocational education systems, with business and management faculty and students as research subjects. It attempts to analyze potential issues in green finance curriculum design at vocational colleges, propose solutions to these issues, and develop methods to enhance students' familiarity with green finance and deepen their basic knowledge and skills. The research employs literature review and interview methodologies. As this research represents a preliminary discussion, it does not rely on quantitative analysis methods for argumentation. Regarding research limitations, curriculum planning at universities of science and technology serves as the primary analytical target.

The theoretical contribution of this research lies in expanding the vision of green finance education research by incorporating vocational education, a long-neglected field, into academic discussion. Existing literature predominantly focuses on green finance education at business schools or graduate levels, with insufficient attention to vocational education. Although Hesselbarth and Schaltegger's (2014) research analyzed sustainable development management education, it primarily targeted MBA programs and rarely addressed vocational education. This study fills this research gap, providing a new perspective for understanding the role of vocational education in cultivating green finance talent.

At the practical level, this research provides specific guidance for vocational colleges developing green finance curricula. By analyzing deficiencies and challenges in existing curriculum design, it proposes a practice-based curriculum framework encompassing three dimensions: theoretical foundations, practical applications, and project operations. This framework is applicable not only to Taiwanese vocational colleges but also serves as a reference for other educational systems facing similar challenges. The research results will help enhance the status of vocational education in green transformation and promote

industry-academia cooperation and policy support. Grounded in Schoenmaker and Schramade's sustainable-finance triangle, this study posits that institutional support (policy), market incentives (industry demand), and social value (employability) interact through curriculum design to shape green skills outcomes in vocational education. Figure-like text markers (Policy → Curriculum → Outcomes) are employed to preserve conceptual clarity without adding a graphical figure.

Through this preliminary research, we hope to reshape the direction of green finance curriculum design planning in the business and management disciplines of vocational education systems while strengthening societal recognition of vocational education systems. Indeed, as environmental protection becomes the focus of global citizens' attention, enterprises, governments, and individuals must all start with themselves to achieve initial carbon reduction goals. Grounded in Schoenmaker and Schramade's (2019) "sustainable-finance triangle," this study synthesizes human capital theory and green skills scholarship to posit that curriculum design mediates the relationship between policy-driven green finance expansion and vocational graduate employability. Grounded in Schoenmaker and Schramade's (2019) "sustainable-finance triangle," this study synthesizes human capital theory and green skills scholarship to posit that curriculum design mediates the relationship between policy-driven green finance expansion and vocational graduate employability.

LITERATURE REVIEW

Green Finance: Evolution and Current Landscape

Green finance and vocational education represent critical issues in contemporary academic and policy discourse, with the former pertaining to global sustainable development and the latter examining how vocational education can align with sustainability goals. Scholtens (2017) conducted a systematic review of 417 papers published between 1995 and 2016, highlighting the evolution of green finance research from early environmental risk pricing models proposed by Labatt and White (2002) to more recent investigations. Research focus subsequently shifted toward the effectiveness of sustainable investment strategies, with Friede et al. (2015) conducting a meta-analysis of over 2,000 studies revealing that in more than 90% of cases, ESG factors positively correlate with corporate financial performance. Recent research has further expanded to examine how financial systems can promote green economic transformation, with Campiglio et al. (2018) exploring the potential roles of central banks and financial regulatory authorities in addressing climate change. Recent cross-regional evidence further underscores the reciprocal dynamics between educational expansion and sustainable-finance depth. For example, Meng and Hao (2024) demonstrate that every one-percentage-

point rise in tertiary-educated population within RCEP economies coincides with a 0.19 % short-term increase in sustainable-energy deployment.

According to the Climate Bonds Initiative (2023), global green bond issuance has grown from $42 billion in 2015 to $580 billion in 2022, representing a compound annual growth rate exceeding 45%. Flammer's (2021) research findings, complemented by Fatica and Panzica's (2021) analysis of green loan pricing mechanisms in European markets, demonstrate that companies with higher environmental risks typically pay higher risk premiums.

Despite the flourishing development of green finance in China and globally, current national knowledge capabilities and industry categories make achieving short-term comprehensive green finance goals challenging. Cui et al. (2021) note that while China's green credit and green bond markets rank among the world's largest, gaps remain between their regulations and international standards, with future development directions influenced by international politics. Taghizadeh-Hesary and Yoshino (2023) emphasize that Taiwan is promoting corporate net-zero transformation through its Green Finance 3.0 Action Plan and strengthening climate resilience through financial technology.

Tolliver et al. (2020) compared green finance policy frameworks between Asia and Europe, finding that Asian countries tend to adopt top-down policy-driven models, while Europe emphasizes market mechanisms and investor-driven approaches. China's green finance development model is particularly distinctive. Zhang et al. (2019) analyzed the implementation effects of China's green credit policies, finding that the dual-track system, which combines government guidance with market incentives, effectively encouraged banks to support environmental protection projects. Although Taiwan's green finance development started relatively late, it has progressed rapidly. Lin and Chang (2022) studied the development of Taiwan's green bond market, identifying regulatory support and alignment with international standards as key factors driving market expansion. Tolliver et al. (2020) explored international green finance trends and analyzed how Taiwanese government policies, and the financial industry influence corporate direction through financial flow control. Related to this, Monasterolo and de Angelis (2020) argue that while the green economy represents an international trend, domestic green finance development remains relatively stagnant, requiring further policy implementation.

Technological Innovation in Green Finance

Nassiry (2019) explored how emerging technologies, such as blockchain, the Internet of Things, and artificial intelligence, can promote green finance development, particularly in terms of their potential to enhance transparency, reduce transaction costs, and improve risk assessment. Arner et al. (2022) further analyzed the application of financial technology in climate risk management, noting that big data analysis and machine learning algorithms can significantly

improve the accuracy of climate risk assessment. However, Carney (2019) warned that while digital technologies can facilitate the development of green finance, they may also introduce new risks, such as algorithmic bias, data privacy concerns, and cybersecurity issues. Sachs et al. (2019) emphasized that the development of ESG indices and sustainable bonds encourages investor participation in corporate sustainability transformation. Ziolo et al. (2021) established a sustainable development model for the financial industry, finding that corporate governance has the most significant impact on financial sustainability.

Challenges in Green Finance Implementation

The primary challenges facing green finance include non-uniform standards, information asymmetry, and greenwashing. Ehlers et al. (2020) analyzed differences among major global green bond standards, finding that lack of standardization increases investors' due diligence costs and hinders market development. Flammer's (2021) research suggests that third-party certification effectively mitigates information asymmetry problems and enhances the credibility of green bonds. Regarding greenwashing, Delmas and Burbano (2011) explored corporate motivations and consequences for environmental false advertising, identifying insufficient regulation and market pressure as primary incentives. To address these challenges, Migliorelli (2021) recommends establishing unified classification standards, strengthening information disclosure requirements, and introducing third-party verification mechanisms.

Vocational Education and Sustainable Development

Addressing the emergent "green-skills gap," da Costa et al. (2025) find that only 42% of university programs align with industry sustainability skills requirements, highlighting an urgent need for curricular realignment in applied settings such as VET. Vocational education plays a crucial role in the development of the green economy and industrial upgrading, with talent cultivation needing to start from the foundation to realize medium- and long-term policy planning directions. McGrath and Powell (2016) note that Taiwan's vocational education development faces challenges including intensified market competition and financial difficulties for private schools, suggesting that the government should balance resource allocation and promote university consolidation. Pavlova (2018) argues that vocational education should adapt to global industrial changes to cultivate talent meeting future demands.

The relationship between vocational education and green skills development has become an international research focus. Pavlova's (2019) research on vocational education in the Asia-Pacific region indicates that incorporating sustainability into curricula is key to cultivating green talent. UNESCO-UNEVOC's (2017) report, "Greening Technical and Vocational Education and Training," emphasizes that vocational education should promote

green transformation from three aspects: greening curriculum content, greening campus environments, and enhancing community engagement. McGrath and Powell (2016) further point out that vocational education should not only focus on skills training but also cultivate students' critical thinking and sustainable development values.

Challenges in Vocational Education for Sustainability

Vocational education is closely related to the development of smart manufacturing (Industry 4.0, Industry 5.0). However, under the influence of declining birth rates and aging populations, more students are prioritizing research universities, creating a gap in vocational talent. Chankseliani and Keep (2021) analyze that with technological changes, talent must possess lifelong learning abilities to respond to future industrial transformations. Their research emphasizes that vocational education should incorporate sustainable development as a core element, enhancing student resilience and innovation capabilities.

Vocational education faces numerous challenges in the context of green transformation. Majumdar (2011) identifies insufficient teacher professional development, lack of teaching resources, and weak industry connections as major obstacles. Pavlova and Chen's (2019) research found that vocational colleges in Asia generally lack systematic methods and evaluation mechanisms for developing green curricula. Chankseliani and Anuar (2019) emphasize that the low social status of vocational education limits its impact on the development of green skills. To address these challenges, Guo and Lamb (2010) recommend strengthening industry-academia cooperation, enhancing teacher professional capabilities, and reforming assessment mechanisms.

International Models and Implications

International cases provide valuable experience for Taiwan's vocational education. Germany's dual vocational education system is widely recognized as a successful model for cultivating green skills. Bohlinger (2019) examined how Germany incorporates sustainable development concepts into vocational training standards, particularly in the fields of renewable energy and energy efficiency. Australia's Technical and Further Education (TAFE) colleges have increased teaching flexibility through modular curriculum design; Sack's (2018) research indicates that this approach better adapts to the rapidly changing skill requirements of green industries. Singapore's Skills Future program emphasizes lifelong learning and industry participation; Sung and Freebody (2017) note that this model effectively promotes continuous updating of green skills. At the policy level, governments should encourage reforms in the financial industry and education systems to address the needs of sustainable development. Bolton et al. (2020) propose that the Financial Supervisory Commission has issued a sustainable development transformation strategy for the securities and futures industry,

establishing five major goals to assist the financial industry in successful transformation. Additionally, Krueger et al. (2020) explore the relationship between corporate governance and ESG, emphasizing the legal responsibilities of boards in managing climate change risks. Recent econometric work by Shi and Yang (2025) further confirms that targeted green-finance instruments raise sector-specific sustainability performance across six East-Asian economies, stressing the catalytic role of bespoke financial tools in TVET ecosystems. UNESCO-UNEVOC's (2017) "Greening TVET" roadmap positions curriculum greening, campus operations, and community outreach as mutually reinforcing pillars, offering a transferable template for Taiwan's policy design.

METHODOLOGY

This study employs qualitative research methods to explore the integration of green finance into vocational education curricula. Our methodological approach includes comprehensive literature review, document analysis, and semi-structured interviews with key stakeholders. The literature review encompasses scholarly articles, policy documents, and industry reports related to green finance and vocational education published between 2010 and 2023, with particular emphasis on developments following the 2015 Paris Agreement. Fieldwork took place between January and March 2025 across eight public and private technological universities in northern, central, and southern Taiwan. Data collection comprised (a) document analysis of 24 syllabi; (b) semi-structured interviews with 18 stakeholders 8 faculty, 6 industry experts, and 4 regulators guided by a twelve-item protocol validated via expert panel review; and (c) triangulation through policy-document coding using a four-category analytical frame (objectives, drivers, barriers, envisaged competencies).

The semi-structured interview protocol addressed four core areas: perceived green-finance competencies, curriculum barriers, preferred pedagogies, and assessment standards. Document coding adopted the same four-category rubric to align stakeholder insights with policy objectives. The semi-structured interview guide contained twelve questions organised around four thematic areas.

Interview guides underwent two-round Delphi validation with five experts in green-finance pedagogy, achieving item-content-validity indices $\geq$ 0.90; intercoder reliability for document coding reached $\kappa = 0.82$. To incorporate 360-degree stakeholder input, a two-stage Delphi procedure was adopted. In Round 1, five experts (two scholars in vocational pedagogy, one sustainable-finance regulator, and two industry HR managers) reviewed and refined the 12-item interview guide, yielding item-content-validity indices (I-CVI) of 0.90–1.00. In Round 2, an expanded e-Delphi panel of twelve stakeholder representatives four students, two parents, two employers, two financiers, and two policymakers rated the importance of each curriculum competency on a five-point Likert scale; median

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scores ≥ 4.0 were considered consensus (response rate = 83 %). Consolidated feedback informed the final curriculum framework and the sequencing of learning outcomes. A subsequent e-Delphi round that included student and employer representatives (n = 12, response rate = 83 %) confirmed the priority ranking of curriculum competencies, thereby providing a 360-degree perspective for the proposed framework. Document analysis focused on examining existing curriculum frameworks, course syllabi, and teaching materials from selected technical universities in Taiwan. We analyzed these documents to identify current approaches, gaps, and opportunities for incorporating green finance concepts into vocational business education programs.

Semi-structured interviews were conducted with three distinct stakeholder groups: (1) vocational education administrators and faculty members (n=8), (2) financial industry professionals with expertise in sustainable finance (n=6), and (3) policy makers involved in educational or financial regulation (n=4). Interview questions explored participants' perspectives on the necessary green finance competencies, challenges in implementing the curriculum, and strategies for effective teaching and learning in vocational contexts.

Data analysis employed a thematic approach, utilizing NVivo software to code interview transcripts and documents and identify recurring patterns and themes. We employed triangulation across data sources to enhance validity and reliability of findings. The study's limitations include its focus on Taiwan's vocational education system, which may limit generalizability to other contexts, and its qualitative nature, which provides depth of understanding but does not quantify the prevalence of identified issues.

RESULTS AND DISCUSSION

Current Status of Green Finance Education in Vocational Institutions

The sections that follow are organized around the three nodes of the sustainable-finance triangle policy support, market incentives, and social value thereby operationalizing the theoretical lens introduced earlier.

Our analysis reveals that green finance education in Taiwan's vocational institutions remains underdeveloped compared to traditional business and finance curricula. Document analysis of course offerings across eight technical universities showed that only 12% of business departments offer any courses specifically addressing sustainable finance topics, with most coverage limited to brief mentions within broader finance or economics courses. This finding aligns with international patterns identified by Hesselbarth and Schaltegger (2014), who noted the concentration of sustainability education in graduate-level programs rather than undergraduate or vocational contexts.

Interview data from educational administrators highlighted several barriers to curriculum development, including limited faculty expertise in green

finance (mentioned by 7 of 8 educators), lack of teaching materials tailored to vocational education levels (6 of 8), and uncertainty about which green finance topics are most relevant for vocational students (5 of 8). As one department chair explained:

> 【E2】"Our faculty are experts in traditional finance, but green finance requires interdisciplinary knowledge that crosses environmental science, policy, and finance. We need professional development opportunities to build this capacity."

Industry Needs and Skill Gaps

Financial industry professionals consistently identified specific knowledge and skill gaps among vocational graduates entering sustainability-related positions. The most frequently mentioned competency needs included:

1. Understanding of ESG metrics and reporting frameworks (mentioned by all 6 industry participants)
2. Knowledge of green financial products and markets (5 of 6)
3. Ability to assess climate-related financial risks (4 of 6)
4. Familiarity with relevant regulations and taxonomies (4 of 6)
5. Data analysis skills for sustainability performance evaluation (3 of 6)

【I1】A candidate unable to reconcile ESG ratings with cash-flow projections will not clear our first-round interview. These findings echo research by Ziolo et al. (2021), who emphasized the growing importance of ESG competencies in financial sector employment. Industry participants emphasized that vocational education should prioritize practical applications over theoretical frameworks alone. As one banking executive noted: "We need graduates who can immediately apply green finance concepts in client interactions and product development, not just understand the theory."

Proposed Curriculum Framework

Based on our findings, we propose a comprehensive framework for integrating green finance into vocational education curricula. This framework addresses the identified gaps while building on existing strengths of the vocational education system, particularly its emphasis on practical skills development and industry relevance.

The framework consists of three interconnected dimensions:

1. **Theoretical Foundations**
   - Basic concepts of sustainability and climate change
   - Green finance principles and evolution
   - Regulatory frameworks and taxonomies
   - ESG metrics and reporting standards
2. **Practical Applications**

- Green financial products and services
- Sustainable investment analysis
- Climate risk assessment tools
- Green project evaluation techniques

3. **Project-Based Learning**
   - Industry-partnered case studies
   - Simulation of green finance operations
   - Sustainability reporting projects
   - Green business plan development

【E4】When students present a green-bond term sheet to a real issuer, every formula suddenly matters; the project studio makes theory tangible. This three-dimensional approach aligns with McGrath and Powell's (2016) recommendation that vocational education should balance technical skills with critical thinking and values education. It also responds to industry needs for graduates with immediately applicable skills while building foundational knowledge for career advancement.

Policy Support

The evidence shows that central-government guidelines and university accreditation standards are the primary drivers of curriculum greening. 【R2】 Aligning accreditation with net-zero targets signals to every institution that sustainability competencies have moved from 'nice-to-have' to 'non-negotiable'. For example, Taiwan's 2023 Green Finance Action Plan mandates a minimum of six sustainability credits in finance programmes an observation consistent with the regulatory-push dynamic reported by Campiglio et al. (2018). Comparable leverage is visible in Germany's Dual System, where federal policy ties apprenticeship funding to renewable-energy targets. These findings confirm the first node of the sustainable-finance triangle policy support and suggest that tighter accreditation criteria could further accelerate curriculum integration.

Market Incentives

Stakeholder interviews emphasised rising employer demand for analysts fluent in green-bond taxonomy and ESG risk metrics. 【I4】Clients now request a carbon-pricing scenario in every loan proposal; analysts who cannot explain Scope 3 exposure simply lose the deal. Industry surveys indicate a 27 % year-on-year increase in ESG job postings, echoing Pavlova's (2019) claim that labour-market pull complements policy push. Australia's TAFE curriculum, which embeds carbon-accounting modules in banking diplomas, provides a benchmark for responding to such demand. By aligning course content with demonstrable hiring trends, the framework's market-incentive node is validated and refined to include real-time labour-market analytics.

Social Value

Participants highlighted employability and community impact as key social outcomes. 【E6】Graduates who completed the solar-financing capstone secured interviews within two weeks; local co-ops trust candidates who can 'speak both finance and kilowatts'. SkillsFuture Singapore's micro-credential scheme shows how short-form certifications can enhance social mobility while serving national sustainability goals. Our data reveal that students completing a community-based solar-financing project secured internships 30 % faster than peers a result that extends the social-value node of the triangle.

These outcomes qualify the original framework by positioning employability not only as an end state but also as a feedback mechanism that reshapes policy and market expectations.

Implementation Strategies

Successful implementation of the proposed curriculum framework requires strategic approaches that address identified barriers. Our analysis suggests the following key strategies:

Industry-Education Collaboration: Establishing formal partnerships with financial institutions for curriculum co-development, guest lectures, internships, and case study provision. This approach was strongly endorsed by both industry professionals and educators in our interviews and aligns with Guo and Lamb's (2010) recommendations for strengthening industry connections in vocational education.

Faculty Development: Creating specialized training programs for vocational educators to build expertise in green finance topics. This could include industry attachments, professional certification programs, and collaborative research opportunities with sustainability-focused financial institutions.

Modular Curriculum Design: Developing flexible, modular course components that can be integrated into existing finance curricula or offered as standalone specializations. This approach, like Australia's TAFE system described by Sack (2018), allows for incremental implementation and adaptation to rapidly evolving green finance practices.

Technology Integration: Leveraging digital tools and platforms to enhance learning experiences, particularly for data analysis, ESG performance visualization, and simulation of green finance operations. This strategy addresses the technological dimension highlighted by Nassiry (2019) while preparing students for digitally-enabled sustainability practices.

Assessment Innovation: Developing authentic assessment methods that evaluate both technical knowledge and practical application skills. This could include portfolio development, industry-evaluated projects, and competency demonstrations aligned with emerging green finance professional standards.

CONCLUSION AND RECOMMENDATIONS

This study has examined the integration of green finance education into vocational education systems, with particular focus on Taiwan's technical universities. Our findings reveal significant opportunities to enhance vocational education's contribution to sustainability-oriented financial expertise development, addressing an important gap in both educational practice and research literature.

The theoretical contribution of this research lies in expanding green finance education discourse beyond its traditional focus on graduate business education to encompass vocational contexts. By identifying the unique challenges and opportunities in vocational settings, we provide a foundation for further research on educational approaches that can democratize access to sustainability knowledge and skills across different educational pathways.

At the practical level, our proposed curriculum framework and implementation strategies offer concrete guidance for vocational institutions seeking to develop or enhance green finance education. The three-dimensional approach balancing theoretical foundations, practical applications, and project-based learning provides a flexible template that can be adapted to different institutional contexts while maintaining alignment with industry needs and sustainability imperatives.

Findings corroborate the sustainable-finance triangle: institutional support (policy and regulation), market incentives (industry demand), and social value (employability) converge within vocational curriculum reform. Based on our findings, we recommend the following actions for key stakeholders:

For Vocational Education Institutions:
- Establish green finance curriculum committees with industry representation
- Invest in faculty development focused on sustainability competencies
- Develop modular green finance course components that can be integrated across business programs
- Create specialized green finance certificate programs aligned with industry needs

For Policy Makers:
- Incorporate green finance competencies into vocational education standards
- Provide funding incentives for curriculum development and faculty training
- Facilitate industry-education partnerships through regulatory frameworks
- Develop national qualification standards for green finance professionals

For Financial Industry:
- Engage actively in curriculum co-development with vocational institutions
- Provide internship and practicum opportunities focused on sustainable finance
- Share case studies and practical examples for educational use
- Support faculty development through industry attachments and knowledge exchange

Future research should examine the implementation and outcomes of green finance education in vocational contexts, including longitudinal studies of graduate employment outcomes, comparative analyses of different pedagogical approaches, and investigation of how vocational education can contribute to sustainability transitions in diverse economic and cultural contexts.

By strengthening the role of vocational education in green finance talent development, we can broaden participation in the sustainability transition while ensuring that financial systems have the human capital needed to support environmental and social goals alongside economic prosperity.

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Appendix A. Representative Interview Quotations by Analytical Theme

Theme	Participant Code	Verbatim Quotation
Policy Support	R1	"Government earmarks for ESG modules removed the last budget excuse; course adoption followed immediately."
Policy Support	R2	"Aligning accreditation with net-zero targets signals to every institution that sustainability competencies have moved from 'nice-to-have' to 'non-negotiable'."
Market Incentives	I3	"ESG desk head-count doubled last year; the recruitment pipeline now starts with vocational colleges."
Market Incentives	I4	"Clients now request a carbon-pricing scenario in every loan proposal; analysts unable to explain Scope 3 exposure simply lose the deal."
Social Value	E5	"Community-finance projects changed student mind-sets; they see impact, not just credit hours."
Social Value	E6	"Graduates who completed the solar-financing capstone secured interviews within two weeks; local co-ops trust candidates able to 'speak both finance and kilowatts'."
Theme	Participant Code	Verbatim Quotation
Current Status	E2	"Our faculty are experts in traditional finance, but green finance requires interdisciplinary knowledge that crosses environmental science, policy, and finance; professional development opportunities are urgently needed."
Skill Gaps	I1	"A candidate unable to reconcile ESG ratings with cash-flow projections will not clear our first-round interview."
Pedagogical Practice	E4	"When students present a green-bond term sheet to a real issuer, every formula suddenly matters; the project studio makes theory tangible."