

TVET, AI AND GREEN HRM FOR SUSTAINABLE WORKFORCE DEVELOPMENT: A CONCEPTUAL FRAMEWORK

Nur Amirah Borhan^{1*}

Afiqah Mohd Bakri²

Rusliza Yahaya³

Azrizal Husin⁴

¹Faculty of Management & Economics, Universiti Pendidikan Sultan Idris, 35950 Tanjung Malim, Perak, Malaysia (Email: amirah.borhan@fpe.upsi.edu.my)

²Faculty of Business & Accountancy, University Poly-Tech Malaysia, 56100 Kuala Lumpur, Malaysia (Email: afiqah_bakri@uptm.edu.my)

³Faculty of Management & Economics, Universiti Pendidikan Sultan Idris, 35950 Tanjung Malim, Perak, Malaysia (Email: rusliza@fpe.upsi.edu.my)

⁴Faculty of Management & Economics, Universiti Pendidikan Sultan Idris, 35950 Tanjung Malim, Perak, Malaysia (Email: azrizal@fpe.upsi.edu.my)

*Corresponding author: amirah.borhan@fpe.upsi.edu.my

Article history

Received date : 27-10-2025

Revised date : 28-10-2025

Accepted date : 29-11-2025

Published date : 10-12-2025

To cite this document:

Borhan, N. A., Mohd Bakri, A., Yahaya, R., & Husin, A. (2025). TVET, AI and green HRM for sustainable workforce development: A conceptual framework. *Journal of Islamic, Social, Economics and Development (JISED)*, 10 (79), 81 – 95.

Abstract: *The global pursuit of sustainable and ethical development has heightened the need for a workforce equipped with Environmental, Social, and Governance (ESG) competencies. In this transformation, Technical and Vocational Education and Training (TVET) institutions play a pivotal role in nurturing talent aligned with the values of environmental stewardship, social responsibility, and economic resilience. However, many TVET systems in developing nations remain underprepared to integrate ESG principles or harness emerging technologies such as Artificial Intelligence (AI) to enhance green skills formation. Grounded in the Resource-Based View (RBV) and Institutional Theory, and guided by the Islamic principles of amanah (trust), khalifah (stewardship), and maslahah (public good), this conceptual paper develops a multi-theoretical framework linking three key drivers, i.e. AI integration in human resource development, ESG-embedded curriculum, and industry–TVET collaboration, with the formation of an ESG-ready workforce, while positing Green Human Resource Management (Green HRM) practices as a moderating factor. This framework offers a holistic understanding of how education and employment ecosystems interact to foster sustainability-oriented talent. By embedding Islamic ethical principles and ESG values in workforce development, the framework contributes to the foundations of ethical, inclusive, and responsible economic growth, particularly relevant to emerging economies such as Malaysia. The paper concludes with policy interventions that can advance sustainable and ethically grounded human capital development in Malaysia and directions for future empirical validation.*

Keywords: *TVET, ESG, Green HRM, Artificial Intelligence, Workforce Readiness, Islamic Ethics*

Introduction

The increasing global emphasis on sustainability and ethical development reflects a critical transformation in education systems and labor markets as nations strive to fulfil the Sustainable Development Goals (SDGs) and promote green economic transitions. A prominent aspect of this shift is the need for a workforce adept in Environmental, Social, and Governance (ESG) principles, which are integral for ensuring sustainable practices across various economic sectors (Popelo et al., 2023; Puzyrova, 2024). Beyond regulatory compliance, ESG competencies are now viewed as strategic organizational resources that determine an organization's resilience, competitiveness, and ethical legitimacy in the global market (Liu, 2025; Ooi & Memon, 2025; Solaimani, 2024). This argument is consistent with the Resource-Based View (RBV), which posits that human capital and capabilities are key sources of sustained advantage (Jalloh & Ming, 2020).

Within this context, Technical and Vocational Education and Training (TVET) institutions play a significant role as catalysts in fostering sustainable human capital development. By equipping students with technical expertise, environmental awareness, and ethical consciousness, TVET serves as the bridge connecting education, industry, and societal welfare. This helps nations achieve a balance between economic growth, social equity, and environmental preservation in pursuit of the broader goal of *maslahah* (public good) (Maclean, Jagannathan, & Sarvi, 2013; Ogur, 2023; Thevathas & Zakaria, 2024). From an Institutional Theory perspective, TVET systems also respond to coercive, normative, and mimetic pressures arising from national policies, accreditation standards, and industry expectations, to adopt ESG-oriented practices that align with global sustainability norms (DiMaggio & Powell, 1983; Lee & Isa, 2023).

From an Islamic perspective, workforce preparation is not solely an economic activity but also a moral responsibility. The concepts of *khalifah* (stewardship) and *amanah* (trust) underscore humanity's duty to manage resources responsibly and to uphold justice in economic participation, all in pursuit of *maslahah* (public good) (Chapra, 2008; Khalidin, Musa, Fardesi, & Ulfia, 2024). By embedding moral and ethical intent within resource utilization and institutional behavior, Islamic values complement the RBV and Institutional Theory. Hence, integrating these ethical foundations into TVET curriculum and workforce strategies aligns education with both sustainability and faith-based development paradigms. In this case, TVET institutions are well-positioned to cultivate graduates who are not only technically competent but also ethically driven to safeguard natural resources, promote social equity, and act as responsible stewards of their communities' shared resources (Lee, Kuang, Tee, & Liew, 2025; Thevathas & Zakaria, 2024).

However, despite the growing recognition of sustainability's importance, the operationalization of ESG principles within educational systems remains fragmented and uneven. Many higher education institutions remain at different stages of ESG implementation, as institutional, financial, and governance barriers hinder its effective incorporation into Malaysian educational frameworks (Ibrahim, Abdul Rahim, & Iqbal, 2024; Ibrahim & Rahim, 2024). In addition, the Malaysian TVET ecosystem continues to face challenges in embedding ESG-oriented curricula, strengthening green skill pathways, and building meaningful linkages with industry partners (Ibrahim et al., 2024). These challenges include limited funding, insufficient teacher training, outdated infrastructure, a lack of practical green teaching materials, and persistent industry-academia disconnects (Kanapathy, Lee, Mokhtar, Syed Zakaria, & Sivapalan, 2021; Mahmud, 2017; Osman, Ibrahim, Koshy, & Muslim, 2015; Teh, 2024; Yeo, Lim, Tay, & Chin, 2025).

At the same time, the rapid advancement of Artificial Intelligence (AI) presents both an opportunity and a challenge. While AI can potentially enhance both learning and labor-market alignment by enabling data-driven curriculum design, personalized learning, and predictive analytics for green skill demand forecasting (Ejjami, 2024; Sern et al., 2021; Yazdaniyan et al., 2022; Zulkarnaini, Samsuden, Fong, & Sambath, 2025), its integration into ESG-focused education remains underexplored. Existing studies have not sufficiently examined how AI-driven educational innovation can be strategically leveraged within ethically grounded and institutionally constrained environments. Furthermore, digital divides, cost barriers, and shortages of AI-literate educators continue to impede effective adoption (Ishrat, Khan, Faisal, Ansari, & Ahmad, 2025; Matiwane & Olaitan, 2025).

Furthermore, industry–TVET collaboration is crucial to ensure that education remains demand-driven rather than purely academic (Hussain, Zulkifli, Kamis, Threeton, & Omar, 2021). Effective collaboration enables TVET institutions to develop curriculum that directly reflect the skills and competencies demanded by employers (Jamaludin, Hamid, & Alias, 2023). Yet, such partnerships often lack coordination mechanisms and standardized indicators to evaluate their effectiveness. This situation not only limits Malaysia’s efforts to align with global sustainability targets but also highlights the urgent need for a unified framework that connects curriculum reform, technological innovation, and industry engagement to prepare an ESG-ready workforce (Che Rus et al., 2023; Nthako & Khumalo, 2025).

In this evolving landscape, Green Human Resource Management (Green HRM) emerges as a crucial mechanism that determines how effectively these educational and technological innovations translate into sustainable workforce outcomes. Green HRM encompasses practices such as responsible recruitment, training, performance appraisal, and organizational culture that embed sustainability values across organizational processes (Ali, Rus, & Noor, 2023). Therefore, Green HRM has the potential to strengthen the influence of ESG-oriented education, AI integration, and industry–TVET collaboration on workforce readiness by ensuring that the skills, mindsets, and sustainability values cultivated within educational systems are reinforced and operationalized within organizational and industrial contexts.

Accordingly, this paper introduces a conceptual framework grounded in the Resource-Based View and Institutional Theory, and supported by Islamic ethical principles, to explain how three critical dimensions, i.e. AI integration, ESG-embedded curriculum, and industry–TVET collaboration, collectively enhance sustainable workforce outcomes through the moderating role of Green HRM. The framework aims to provide both theoretical and policy insights for Malaysia’s transition toward a sustainability-oriented and ethically responsible human capital ecosystem. Specifically, this study seeks to:

1. Examine how AI, ESG-integrated curricula, and industry–TVET collaboration contribute to preparing ESG-ready graduates.
2. Conceptualize the moderating role of Green HRM in strengthening the relationship between educational and technological drivers and sustainable workforce outcomes.
3. Offer a testable conceptual model for future empirical research, policy formulation, and institutional application.

Literature Review

TVET, ESG Competencies and Sustainable Workforce Development

Technical and Vocational Education and Training (TVET) systems are central to national strategies for employment creation, social inclusion, and sustainable economic growth (Nazzal et al., 2024). As economies transition toward low-carbon and responsible production systems, the demand for ESG-oriented skills has intensified (Popelo et al., 2023; Puzyrova, 2024). From a Resource-Based View (RBV), such competencies represent strategic human capital that enhances competitiveness and resilience. Hence, TVET institutions act as capability builders in preparing a workforce capable of advancing sustainability goals through technical proficiency and ethical awareness (Maclean et al., 2013; Ogur, 2023; Thevathas & Zakaria, 2024).

UNESCO and the International Labour Organization (ILO) emphasize that sustainability should not only be an environmental agenda but a developmental one by integrating economic resilience, social justice, and human well-being (UNESCO, 2020; International Labour Organization, 2023). This expansive viewpoint emphasizes the necessity for TVET systems to cultivate learners endowed with multifaceted competencies that correspond with sustainable development goals and socially responsible practice. Within the Islamic worldview, the role of TVET resonates with the principles of *falah* (holistic success) and *adl* (justice), where education must foster human dignity and societal balance (Ali et al., 2023). By embedding ESG values into TVET programs, nations can cultivate graduates who uphold both professional competence and ethical stewardship toward people and the planet.

AI Integration in Human Resource Development and Training

Artificial Intelligence (AI) has revolutionized the landscape of human capital development by enabling data-driven decision-making and predictive analytics for workforce planning (Selvi, 2024). From the RBV perspective, AI functions as a strategic capability that enhances an institution's ability to generate, manage, and sustain valuable knowledge assets (Day, Jean-Denis, & Karanja, 2025). On the other hand, institutional pressures such as policy directives and industry accreditation standards further encourage TVET institutions to adopt AI-driven solutions that support transparency, efficiency, and ESG alignment (Singleton, 2025).

In the TVET context, AI can optimize curriculum design, enhance adaptive learning, and identify emerging green skill needs in alignment with evolving industrial trends (Subrahmanyam, 2025). This is consistent with previous research, where the result shows that embedding sustainability principles through digital and technological innovations can enhance learners' preparedness for environmentally responsible careers (Jha, 2024). Additionally, AI also enables the creation of personalized learning pathways by analyzing learner data and tailoring content to individual needs by recommending relevant courses, while adjusting the content difficulty in real time to match learner progress (Awashreh & Almi, 2025).

Beyond its technical function, responsible AI adoption also aligns with the Islamic principle of *ihsan* (excellence and benevolence), emphasizing fairness, inclusivity, and accountability in service delivery (Lin et al., 2024). When guided by ethical and sustainable considerations, AI can reduce biases, democratize learning opportunities, and promote sustainability-oriented competencies. Thus, responsible AI adoption in TVET represents not only a technological advancement but also an ethical imperative consistent with Islamic social values and sustainable development objectives (Murari & Parmar, 2025).

ESG-Embedded Curriculum in TVET

Curriculum “greening” involves embedding Environmental, Social, and Governance (ESG) principles across all disciplines to nurture sustainability-oriented mindsets among learners. Integrating ESG concepts within TVET curricula ensures that students acquire the competencies relevant to green jobs, sustainable production, and responsible business practices (Subrahmanyam, 2025). It is also supported by Mesuwini et al. (2025) that effective ESG integration requires more than content inclusion. It demands systematic alignment between educational objectives, occupational standards, and national sustainability policies. Such alignment allows TVET institutions to function as strategic agents supporting the Sustainable Development Goals (SDGs) through workforce readiness and ethical awareness.

From an Islamic ethical lens, curriculum design should also foster *amanah* (trust), *mizan* (balance), and *wasatiyyah* (moderation), reinforcing that human progress must coexist harmoniously with ecological preservation (Andiani et al., 2024). In practice, this may involve embedding ESG themes into competency-based modules, incorporating experiential learning through community and industry partnerships, and training educators to deliver values-based instruction (Alenezi & Alanazi, 2024). A well-structured ESG-embedded curriculum in TVET, therefore, contributes not only to employability but also to moral, environmental, and social consciousness among future professionals, which bridges the gap between economic productivity and ethical stewardship.

Industry–TVET Collaboration for Sustainable Skills Alignment

Effective collaboration between TVET institutions and industries is essential to ensure that training remains responsive to dynamic labor markets and sustainability transitions. Joint initiatives such as co-developed curricula, structured apprenticeships, and ESG-aligned certification programs help bridge the persistent gap between education and employment (Zhao, 2024). These partnerships reflect the Islamic principles of *amanah* (trust) and *maslahah* (public good), emphasizing shared responsibility for societal well-being. When industries and educators work together to promote ethical production and sustainable practices, they embed values of transparency, justice, and stewardship within the broader workforce ecosystem (Nthako & Kumalo, 2025). Such partnerships are vital in developing graduates who can navigate both technological and moral complexities in ESG-driven industries (Pogátsnik, 2021).

Conversely, limited or ad hoc collaboration between TVET providers and ESG-driven industries contributes to persistent skill mismatches and inadequate exposure to real-world sustainability practices (Ahmad & Rosnan, 2024; Ridzuan & Abd Rahman, 2022; Stella, Ahmed, & Simon, 2022). Strengthening such linkages requires continuous curriculum co-design, expansion of internships within the green and digital sectors, and ongoing feedback loops that align training with evolving labor market expectations for sustainable production and responsible innovation (Hussain et al., 2021; Mustapha, Saari, & Jalaludin, 2023; Rajamanickam, Che’ Rus, Abdul Raji, Mina, & Vebrianto, 2024; Goueli, 2024; Jain & Mitra, 2025).

Green Human Resource Management (Green HRM) as a Moderating Mechanism

Green Human Resource Management (Green HRM) refers to the integration of environmental and sustainability principles into HR policies and practices such as recruitment, training, performance appraisal, and rewards (Shafaei, Nejati, & Yusoff, 2020; Adubor et al., 2022; Chaudhary & Chaudhary, 2023). By institutionalizing green values within human capital

systems, Green HRM ensures that sustainability principles are not only learned in classrooms but also practised across organizational processes and employee behavior (Chaudhary & Chaudhary, 2023). In this study, Green HRM is conceptualized as a moderating variable that strengthens the relationship between educational and technological drivers and workforce sustainability outcomes.

AI integration enhances sustainable decision-making and operational efficiency, fostering data-driven and environmentally responsible competencies among employees (Kobets, 2025). ESG-embedded curriculum further builds students' ethical awareness and sustainability skills, preparing them as ESG-ready graduates (Lavena & Anandhi, 2025). Likewise, TVET–industry collaboration connects learning with practice by exposing students to ESG-driven work environments, strengthening their employability for sustainability-focused careers (Najib et al., 2022).

In this landscape, Green HRM strengthens the impact of AI integration by promoting data-driven, environmentally responsible HR practices that reduce waste and improve productivity (Pandey, 2024). It also aligns ESG-embedded curriculum with workplace culture and performance systems, ensuring meaningful application of sustainability skills (Maheshwari et al., 2024). Additionally, Green HRM reinforces TVET–industry collaboration by embedding sustainability values into workforce development initiatives (Najib et al., 2022).

Theoretically, Green HRM operationalizes the Resource-Based View (RBV) by transforming sustainability-oriented skills into strategic organizational capabilities, while Institutional Theory explains how HR practices can diffuse ethical and environmental norms across industries (Islam, Khan, Ahmed, & Mahmood, 2021). Within the Islamic paradigm, the principles of *khalifah* (stewardship) and *amanah* (trust) further reinforce HRM's moral responsibility to nurture employees as custodians of resources. In Malaysia, integrating Green HRM into TVET-linked organizations can bridge the gap between ESG education and workplace implementation, supporting the nation's aspiration for a future-ready, sustainability-driven workforce (Zulkarnaini et al., 2025; Sanwal et al., 2024).

Toward an ESG-Ready Workforce: Integrative Perspectives

An ESG-ready workforce embodies a blend of technical expertise, digital literacy, ethical reasoning, and environmental sensitivity. These qualities are increasingly demanded by sustainable industries. Such a workforce demonstrates adaptability, transparency, and social responsibility, which are essential for achieving national sustainability visions (Awwad, Anouze, & Elbanna, 2025). From an Islamic perspective, an ESG-ready worker represents the ideal balance between *fard kifayah* (collective responsibility) and *amanah* (trust), contributing not just to organizational success but to societal welfare (Al Azizah & Haron, 2024; Lee & Isa, 2023). Developing such talent requires integrating spiritual, ethical, and professional competencies, reinforcing the idea that sustainable development is inherently a moral pursuit (Luetz & Nunn, 2023).

Gaps and Justification for the Model

Despite increasing interest in sustainability-oriented education, existing research on ESG integration within TVET remains fragmented. Prior studies often focus on specific elements such as green skills development (Suhendra et al., 2025), curriculum greening (Daddow, 2022) or industry–TVET partnerships (Nthako & Khumalo, 2025) as isolated initiatives. Few conceptual or empirical studies explore how educational innovation, technological adoption,

and institutional collaboration collectively shape the formation of an ESG-ready workforce, particularly in developing economies.

Another gap lies in the theoretical grounding of sustainability education research. Much of the existing literature adopts descriptive or policy-based perspectives, with insufficient theoretical linkage explaining the mechanisms that transform educational inputs into workforce outcomes (Kumar, 2023). To address this, the present study adopts a dual-theoretical lens, i.e. Resource-Based View (RBV) and Institutional Theory, to justify the proposed conceptual model and provide explanatory depth.

From the RBV perspective (Barney, 1991), ESG-embedded curricula, AI-driven learning, and strong TVET–industry collaboration constitute valuable, rare, inimitable, and non-substitutable resources that enhance human capital quality and organizational competitiveness. When reinforced through Green HRM practices, such resources evolve into sustained advantages that embed sustainability values into workforce culture and long-term behavior.

Meanwhile, Institutional Theory (DiMaggio & Powell, 1983) explains how normative and coercive pressures, such as SDG commitments, ESG disclosure requirements, and government policies, drive TVET and industry actors to institutionalize sustainability practices. Through this lens, TVET institutions and industries respond to these pressures by aligning curricula, technologies, and HR practices with ESG imperatives, thus reinforcing both social legitimacy and ethical accountability.

Positioning Green HRM as a moderating mechanism extends both theoretical perspectives. It posits that Green HRM strengthens the relationship between ESG-oriented education initiatives and workforce readiness by institutionalizing sustainability norms at the organizational level and converting educational competencies into tangible workplace performance. Grounded in the Islamic principles of *amanah* (trust) and *khalifah* (stewardship), this framework highlights the moral and developmental dimensions of sustainability-oriented workforce formation.

Conceptual Framework

The proposed framework (Figure 1) incorporates AI integration, ESG-embedded curriculum, and industry–TVET collaboration as key antecedents shaping the ESG-ready workforce, with Green Human Resource Management (Green HRM) as a moderating mechanism that strengthens these relationships. Anchored in the Resource-Based View (RBV) and Institutional Theory, it posits that sustainable human capital formation depends on both strategic resource deployment and institutional pressures that guide educational and organizational adaptation.

From the RBV perspective, AI-based learning, ESG-oriented curricula, and industry collaboration represent valuable and inimitable capabilities enhancing institutional competitiveness and sustainability readiness (Zulkarnaini et al., 2025). Meanwhile, Institutional Theory further explains how national ESG policies, SDG commitments, and market expectations impose normative and coercive pressures, driving institutions to adopt and legitimize sustainability-aligned practices (Kobets, 2025; Lavena & Anandhi, 2025; Najib et al., 2022). Together, these perspectives link internal capability development with external legitimacy demands.

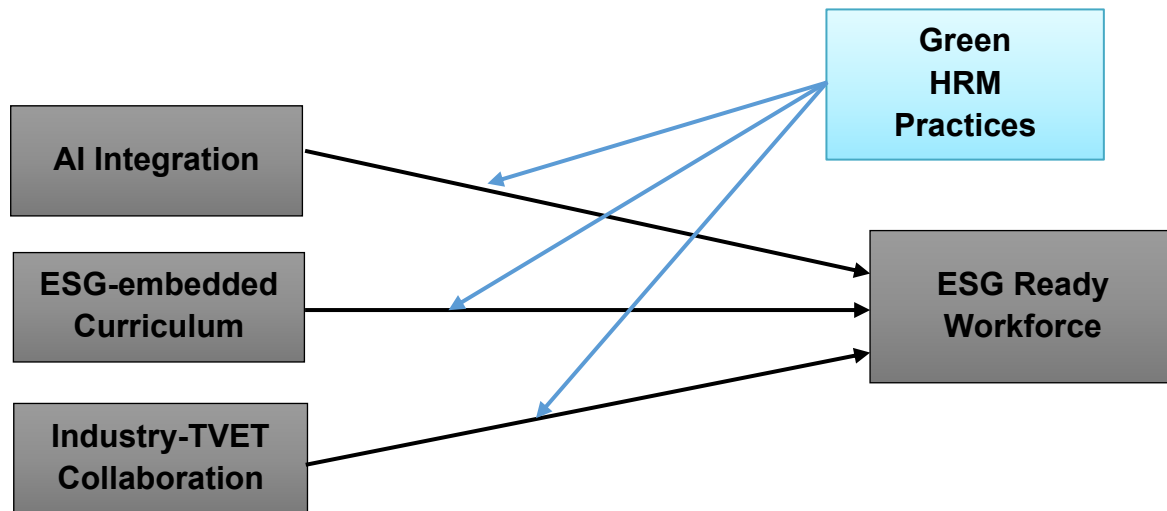


Figure 1: Proposed Conceptual Framework

Within this context, green HRM moderates the relationship between education-driven initiatives and workforce readiness by ensuring that sustainability competencies are reinforced through recruitment, training, and performance systems (Pilania, 2024). TVET institutions supply ESG-skilled graduates, while Green HRM represents the organizational demand side that determines whether these competencies are effectively utilized (Caves et al., 2021). In organizations lacking green HR practices, even highly trained TVET graduates may face challenges in translating their sustainability knowledge into meaningful workplace impact (Kumar, 2023). Hence, Green HRM bridges educational inputs and organizational performance, aligning values and practices across the education-to-employment continuum.

Complementing these theories, Islamic ethical principles provide a moral foundation for sustainability. Concepts such as *mizan* (balance), *amanah* (trust), and *khalifah* (stewardship) emphasize responsible management of human and natural resources, while *maslahah* (public good) reinforces collective welfare (Chuttani, 2024). Through this ethical lens, TVET institutions serve as custodians of stewardship, cultivating graduates who uphold social justice and sustainability.

Methodology and Conceptual Approach

This paper adopts a conceptual research design based on an integrative review of literature across various areas such as sustainability, education, Artificial Intelligence (AI), Green Human Resource Management (Green HRM), and industry–TVET collaboration. The aim is to develop a theoretical framework that explains how these dimensions interact to shape the formation of an ESG-ready workforce in Malaysia.

Relevant publications, policy documents, and institutional reports were critically reviewed to identify recurring themes, theoretical linkages, and research gaps. The analysis was guided by the Resource-Based View (RBV) and Institutional Theory, complemented by Islamic ethical principles such as *khalifah* (stewardship), *amanah* (trust), and *maslahah* (public good), which frame sustainability as both a strategic and moral imperative.

The outcome of this conceptual synthesis is a proposed model that offers testable propositions for future empirical validation and practical implications for sustainable human capital development.

Theoretical and Practical Contributions

This paper advances the discourse on sustainable workforce development by proposing an integrated framework that connects education, technology, and industry under a shared sustainability agenda. By linking Artificial Intelligence (AI), Environmental, Social, and Governance (ESG) education, and Green Human Resource Management (Green HRM), the model demonstrates how technological innovation and ethical governance jointly shape ESG-ready human capital for the future workforce.

From a theoretical standpoint, the framework contributes in three key ways. First, it bridges technological and moral dimensions by illustrating how AI-enabled learning systems can reinforce values-based education grounded in ESG and Islamic ethics. Second, it reconceptualizes Green HRM as a strategic moderating mechanism that translates sustainability ideals into institutional culture and workforce behavior. Third, it integrates educational reform, labor market alignment, and ethical leadership within a cohesive structure, offering a multi-level understanding of how resources and institutions co-evolve toward sustainable human capital formation.

Anchored in the Islamic principles of *amanah* (trust), *khalifah* (stewardship), and *maslahah* (public good), the framework emphasizes that sustainable development requires moral accountability alongside economic advancement. It thereby aligns with the *maqasid al-shariah*, which promotes welfare, justice, and sustainability as the foundation of responsible knowledge creation and employment growth.

Policy and Managerial Implications

On a practical level, the proposed framework provides actionable guidance for policymakers, institutions, and employers in Malaysia and across ASEAN. At the policy level, ministries overseeing education, labor, and industry should embed AI-driven workforce analytics into ESG-aligned TVET strategies to ensure that skills formation remains adaptive to green and inclusive economic transitions.

Institutionally, TVET providers are encouraged to embed ESG and Islamic ethical values throughout their curricula, leveraging digital technologies and industry partnerships to promote experiential learning and sustainability competencies. For employers, adopting Green HRM systems that reward environmental stewardship, ethical conduct, and continuous learning can institutionalize sustainability values within organizational culture and performance.

At a broader societal level, the framework supports Malaysia's commitments under the Twelfth Malaysia Plan, National Energy Transition Roadmap (NETR), and the UN Sustainable Development Goals (SDGs) by cultivating a future-ready, ethically grounded workforce. Collectively, these implications emphasize the importance of integrated and moral governance, a concept rooted in Islamic economic thought where all stakeholders share responsibility for collective well-being. Aligning education, industry, and ethics ensures that national development advances not only productivity but also social equity, environmental care, and enduring moral progress.

Agenda for Future Research

Future studies are encouraged to empirically validate the proposed conceptual framework. Two complementary research pathways are recommended.

First, a promising direction involves leveraging secondary data across institutions or regions to perform panel data analysis. This enables examination of how AI integration, ESG curriculum adoption, and industry–TVET collaboration influence employment outcomes or graduate ESG readiness. Possible proxies include AI-driven training programs, ESG-related courses, green certifications, institutional–industry MoUs, and graduate placement rates. Data can be sourced from DOSM, HRD Corp, UNESCO–UNEVOC, ESG disclosures, and TVET performance databases. Such macro-level analysis helps reveal temporal trends and regional differences in ESG and AI adoption, offering stronger system-level insights.

Second, future research may employ structured survey designs targeting diverse TVET stakeholders, including administrators, instructors, graduates, and industry partners. Constructs derived from the proposed model can be operationalized using validated measurement scales from the Green HRM, sustainability education, and technology acceptance literature. This micro-level approach would enable exploration of stakeholder perceptions, attitudes, and practices regarding AI integration, ESG curriculum embedding, and industry–institution collaboration. It may also examine the moderating role of Green HRM practices and contextual factors such as institutional readiness, policy support, or organizational culture.

Conclusion

This paper proposed a conceptual framework that integrates AI adoption, ESG-embedded curriculum, and industry–TVET collaboration, moderated by Green Human Resource Management (Green HRM), to explain the development of an ESG-ready workforce. The framework highlights the need for education systems, industries, and policymakers to move beyond fragmented sustainability initiatives toward a more integrated, ethically grounded approach of human capital development. Anchored in the Resource-Based View (RBV) and Institutional Theory, the model underscores how technological capability and organizational alignment can be enhanced through sustainability-oriented education and HR practices. Complementing this, the Islamic ethical principles of *khalifah* (stewardship), *amanah* (trust), and *maslahah* (public good) reinforce the moral dimension of workforce development; one that values justice, accountability, and collective well-being alongside productivity and innovation. By linking these perspectives, the framework provides both a strategic and moral blueprint for advancing Malaysia’s sustainability agenda, particularly within the TVET ecosystem. It also establishes a testable foundation for future empirical research, inviting scholars to validate and refine the relationships proposed. Ultimately, preparing an ESG-ready workforce requires not only skills and technology, but also values and vision to ensure that education contributes meaningfully to sustainable, inclusive, and ethically guided national development.

References

- Adubor, N. V., Adenniji, A. A., Salau, O. P., Olajugba, O. J., & Onibudo, G. O. (2022). Exploring green human resource adoption and corporate sustainability in Nigerian manufacturing industry. *Sustainability*, 14(19), 12635. <https://doi.org/10.3390/su141912635>
- Ahmad, M. K. F., & Rosnan, H. (2024). Overcoming Challenges in Malaysia's Technical and Vocational Education: A Path Forward for TVET. *International Journal of Research and Innovation in Social Science*, VIII(IIS), 4986–4994. <https://doi.org/10.47772/IJRISS.2024.803370S>
- Al Azizah, U. S., & Haron, R. (2024). Exploring the Correlation Between ESG Performance and Firm Value in Indonesia Shariah-Compliant Companies. *Journal of Management and Muamalah*, 14(2), 142–160. <https://doi.org/10.53840/jmm.v14i2.193>
- Alenezi, M., & Alanazi, F. (2024). Integrating environmental social and governance values into higher education curriculum. *International Journal of Evaluation and Research in Education*, 13(5), 3493. <https://doi.org/10.11591/ijere.v13i5.29440>
- Ali, N. H. M., Rus, R. C., & Noor, A. I. M. (2023). *Potential green infrastructure in TVET campus: A case study in Teluk Intan Vocational College*. *International Journal of Academic Research in Business & Social Sciences*, 13(15). <https://doi.org/10.6007/ijarbss/v13-i15/18924>
- Andiani, L., Pebriyanti, N., Lestari, T. D., Solihat, Y. N., & Hidayat, Y. R. (2024). *Strategi pengembangan sumber daya manusia berbasis nilai-nilai Islam di MTsN 1 Pangandaran*. *Jurnal Multidisiplin Indonesia*, 2(3). <https://doi.org/10.62007/joumi.v2i3.352>
- Awashreh, R., & Almi, H. (2025). *Revolutionizing education with AI: Personalized learning, predictive analytics, and gamification*. In *Advances in Business Strategy and Competitive Advantage Book Series* (pp. 149–170). IGI Global. <https://doi.org/10.4018/979-8-3693-9440-3.ch006>
- Awwad, A. S., Anouze, A. L., & Elbanna, S. (2025). Green product innovation: Influences on environmental sustainability performance. *Management Decision*. Advance online publication. <https://doi.org/10.1108/md-06-2024-1366>
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120. <https://doi.org/10.1177/014920639101700108>
- Caves, K. M., Ghisletta, A., Kemper, J., McDonald, P., & Renold, U. (2021). Meeting in the middle: tvet programs' education–employment linkage at different stages of development. *Social Sciences*, 10(6), 220. <https://doi.org/10.3390/socsci10060220>
- Chapra, M. U. (2008). *The Islamic Vision of Development in the Light of the Maqasid Al-Shari'ah* (IRTI Occasional Papers No. #235).
- Chaudhary, M. K., & Chaudhary, R. (2023). Green human resource management for organizational sustainability: Lessons from insurance companies in emerging market. *Journal of Emerging Management Studies*, 1(1), 1–19. <https://doi.org/10.3126/jems.v1i1.60159>
- Che Rus, R., Adekunle Salisu, M., Mohammad Hussain, M. A., Mustaffa Kamal, M. F., Hanapi, Z., Oluwatoyin Idris, M., ... Kazeem Kayode, B. (2023). Systematic Review of Malaysia Technical and Vocational Education (TVET) Sustainability Framework to Increase the Marketability of Graduates Using PRISMA. *Jurnal Kejuruteraan*, si6(2), 51–63. [https://doi.org/10.17576/jkukm-2023-si6\(2\)-06](https://doi.org/10.17576/jkukm-2023-si6(2)-06)
- Daddow, A. (2022). “Social Work Students Respond to Greening Social Work Curriculum: ‘It is Important to See a Change in the Narrative.’” *Australian Social Work*, 77(8), 384–396. <https://doi.org/10.1080/0312407X.2022.2135452>
- Day, S., Jean-Denis, H., & Karanja, E. (2025). Extending the Resource-Based View of Social

- Entrepreneurship: The Role of Artificial Intelligence in Scaling Impact. *Journal of Risk and Financial Management*, 18(7), 341. <https://doi.org/10.3390/jrfm18070341>
- DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48(2), 147–160. <https://doi.org/10.2307/2095101>
- Ejjami, R. (2024). AI'S Impact on Vocational Training and Employability: Innovation, Challenges, and Perspectives. *International Journal For Multidisciplinary Research*, 6(4), 1–32. <https://doi.org/10.36948/ijfmr.2024.v06i04.24967>
- Goueli, S. (2024). *Bridging the gap: Integrating learning and workplace experience*. *International Journal of Science of Learning*, 1(2). <https://doi.org/10.56830/ijso112202404>
- Hussain, M. A. M., Zulkifli, R. M., Kamis, A., Threton, M. D., & Omar, K. (2021). Industrial Engagement in the Technical and Vocational Training (TVET) System. *International Journal of Learning, Teaching and Educational Research*, 20(12), 19–34. <https://doi.org/10.26803/IJLTER.20.12.2>
- Ibrahim, N., Abdul Rahim, Z., & Iqbal, M. S. (2024). Exploring Generic Green Skills in Enhancing TVET Curriculum in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 14(10), 1518–1532. <https://doi.org/10.6007/ijarbss/v14-i10/23144>
- Ibrahim, N., & Rahim, Z. A. (2024). Integrating Green Skills into the Malaysian TVET Curriculum: A Systematic Review of Literature. *International Journal of Academic Research in Business and Social Sciences*, 14(11), 1450–1460. <https://doi.org/10.6007/IJARBSS/v14-i11/23671>
- International Labour Organization. (2023). *World Employment and Social Outlook: Trends 2023*. Geneva, ILO. <https://doi.org/10.54394/SNCP1637>
- Ishrat, M., Khan, W., Faisal, S. M., Ansari, M. S. H., & Ahmad, F. (2025). *Future trends and challenges for AI and sustainability in TVET. Integrating AI and Sustainability in Technical and Vocational Education and Training (TVET)*. <https://doi.org/10.4018/979-8-3373-1142-5.ch001>
- Islam, T., Khan, M. M., Ahmed, I., & Mahmood, K. (2021). Promoting in-role and extra-role green behavior through ethical leadership: Mediating role of green HRM and moderating role of individual green values. *International Journal of Manpower*, 42(6), 1102–1123. <https://doi.org/10.1108/IJM-01-2020-0036>
- Jalloh, A. A. A., & Ming, F. (2020). Managing human capital as a strategic source of sustainable enterprise development and competitive advantage. *The International Journal of Management*, 5(1), 20–29. <https://doi.org/10.35940/IJMH.A1124.095120>
- Jamaludin, R. B., Hamid, A. H. A., & Alias, B. S. (2023). Empowering Technical and Vocational Education and Training (TVET). *International Journal of Academic Research in Business and Social Sciences*, 13(12), 2649–2658. <https://doi.org/10.6007/ijarbss/v13-i12/20159>
- Jain, V., & Mitra, A. (2025). *Bridging the digital literacy gap: Effective collaboration between institutes of higher education and the workforce for technology integration* (pp. 71–90). In *Institutes of Higher Education (IHE) and Workforce Collaboration for Digital Literacy*. IGI Global. <https://doi.org/10.4018/979-8-3373-0004-7.ch003>
- Jha, R. (2024). *Incorporating generative AI into human resource practices*. Social Science Research Network. <https://doi.org/10.2139/ssrn.4819491>
- Kanapathy, S., Lee, K. E., Mokhtar, M., Syed Zakaria, S. Z., & Sivapalan, S. (2021). A framework for integrating sustainable development concepts into the chemistry curriculum towards achieving education for sustainable development in Malaysia. *International Journal of Sustainability in Higher Education*, 22(6), 1421–1449.

- <https://doi.org/10.1108/IJSHE-07-2020-0241>
- Khalidin, B., Musa, A., Fardesi, M., & Ulfia, N. (2024). Islamic Economics towards the Sustainability of Economic Development. *International Journal Of Social Science Humanity & Management Research*, 03(11), 1505–1513. <https://doi.org/10.58806/ijsshmr.2024.v3i11n16>
- Kobets, D. (2025). Using artificial intelligence to evaluate ESG indicators in HR practices. *Ekonomika i Upravlinnâ*, 1, 62–67. <https://doi.org/10.32782/2312-7872.1.2025.09>
- Lavena, V., & Anandhi, S. (2025). People-powered sustainability: Embedding human capital in ESG strategy. *International Scientific Journal of Engineering and Management*, 4(9), 1–9. <https://doi.org/10.55041/isjem.esch010>
- Lee, H. S., Kuang, K. S., Tee, W. S., & Liew, P. X. (2025). Human capital and renewable energy transition towards carbon reduction: The role of Technical and Vocational Education and Training (TVET). *IOP Conference Series: Earth and Environmental Science*, 1516(1). <https://doi.org/10.1088/1755-1315/1516/1/012004>
- Lee, S. P., & Isa, M. (2023). Environmental, social and governance (ESG) practices and financial performance of Shariah-compliant companies in Malaysia. *Journal of Islamic Accounting and Business Research*, 14(2), 295–314. <https://doi.org/10.1108/JIABR-06-2020-0183>
- Lin, M. P., Liu, A. L., Poitras, E., Chang, M., & Chang, D. (2024). An exploratory study on the efficacy and inclusivity of AI technologies in diverse learning environments. *Sustainability*, 16(20), 8992. <https://doi.org/10.3390/su16208992>
- Liu, Z. (2025). The Strategic Case for ESG: Risk Management and Long-Term Sustainability. *Advances in Economics, Management and Political Sciences*, 197(1), 53–56. <https://doi.org/10.54254/2754-1169/2025.25678>
- Luetz, J. M., & Nunn, P. D. (2023). Spirituality and sustainable development: An entangled and neglected relationship. *Sustainability Science*, 18(4), 2035–2042. <https://doi.org/10.1007/s11625-023-01347-8>
- Macleane, R., Jagannathan, S., & Sarvi, J. (2013). *Skills Development for Inclusive and Sustainable Growth in Developing Asia-Pacific*. (R. Maclean, S. Jagannathan, & J. Sarvi, Eds.), Technical and Vocational Education and Training: Issues, Concerns and Prospects (Vol. 19). Dordrecht: Springer Netherlands. <https://doi.org/10.1007/978-94-007-5937-4>
- Maheshwari, S., Kaur, A., & Renwick, D. W. S. (2024). Green human resource management and green culture: An integrative sustainable competing values framework and future research directions. *Organization & Environment*, 37(1), 32–56. <https://doi.org/10.1177/10860266231217280>
- Mahmud, S. N. D. (2017). Systems Structure of Education for Sustainable Development in Higher Education Institution. *Creative Education*, 08(09), 1379–1400. <https://doi.org/10.4236/ce.2017.89097>
- Matiwane, B. Y., & Olaitan, O. (2025). Critical Success Factors for Integrating AI Tools into University Curricula for Workforce Readiness. *International Journal of Learning, Teaching and Educational Research*, 24(8), 91–111. <https://doi.org/10.26803/ijlter.24.8.5>
- Mesuwini, J., Ganya, E. S., & Mlotshwa, S. J. (2025). Greening initiatives for TVET colleges through innovative curriculum and technology. In *Advances in Computational Intelligence and Robotics book series* (pp. 297–332). IGI Global. <https://doi.org/10.4018/979-8-3693-8915-7.ch012>
- Murari, U. K., & Parmar, H. (2025). Ethical integration of artificial intelligence in inclusive education. In *Advances in Educational Technologies and Instructional Design Book Series* (pp. 439–470). IGI Global. <https://doi.org/10.4018/979-8-3373-2262-9.ch015>
- Mustapha, A., Saari, A., & Jalaludin, N. A. (2023). Challenges and Collaboration Strategy of

- Industry in the Development of IR4.0 Skills for TVET. *International Journal of Academic Research in Progressive Education and Development*, 12(3), 1075–1081. <https://doi.org/10.6007/ijarped/v12-i3/19001>
- Najib, M. N. A., Ismail, S., & Shah, N. S. A. M. (2022). *COVID-19: The transformation of learning and teaching for skill-based subject*. *International Journal of Academic Research in Progressive Education and Development*, 11(3), 299–308. <https://doi.org/10.6007/IJARPED/v11-i3/13858>
- Nthako, D., & Khumalo, S. S. (2025). Towards a Strategic Framework for Effective TVET-Industry Partnership: Pathways to Sustainable Development. *HOLISTICA – Journal of Business and Public Administration*, 16(1), 73–88. <https://doi.org/10.2478/hjbpa-2025-0005>
- Ogur, E. O. (2023). TVET, economy and sustainable development. *International Journal of Vocational and Technical Education*, 15(2), 12–17. <https://doi.org/10.5897/ijvte2022.0315>
- Ooi, S. K., & Memon, K. R. (2025). Addressing Resource Scarcity: The Role of Responsible Innovation and Resilience in SMEs' Competitive Advantage and Sustainability Performance. *Corporate Social Responsibility and Environmental Management*, 32(5), 5734–5746. <https://doi.org/10.1002/csr.70005>
- Osman, O., Ibrahim, K., Koshy, K., & Muslim, M. (2015). The Institutional Dimension of Sustainability: Creating an Enabling Environment for Sustainability Transformation at USM (pp. 225–238). https://doi.org/10.1007/978-3-319-08837-2_16
- Pandey, D. (2024). *Creating sustainable workplaces through integration of artificial intelligence (AI) and Green HRM practices: An empirical study*. *Journal of Informatics Education and Research*, 4(3). <https://doi.org/10.52783/jier.v4i3.1876>
- Pilania, A. (2024). *Green HRM practices*. *Indian Scientific Journal of Research in Engineering and Management*. <https://doi.org/10.55041/ijsrem33488>
- Pogátsnik, M. (2021). Dual education: connecting education and the labor market. *Opus et Educatio*, 8(3), 304–313. <https://doi.org/10.3311/ope.466>
- Popelo, O., Kholiavko, N., Hryhorkiv, M., Kosmii, O., Oleksiienko, O., & Zhavoronok, A. (2023). EU Higher Education Institution Toward the Sustainable Development. *Management Theory and Studies for Rural Business and Infrastructure Development*, 46(2), 124–132. <https://doi.org/10.15544/mts.2023.13>
- Puzyrova, P. (2024). Experience of the World's Leading Countries in the Context of Sustainable Development of Higher Education Institutions. *Management*, 39(1), 30–40. <https://doi.org/10.30857/2415-3206.2024.1.3>
- Rajamanickam, S., Che' Rus, R., Abdul Raji, M. N., Mina, H., & Vebrianto, R. (2024). Enhancing TVET Education for the Future: A Comprehensive Review of Strategies and Approaches. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, 56(2), 69–91. <https://doi.org/10.37934/araset.56.2.6991>
- Ridzuan, M. R., & Abd Rahman, N. A. S. (2022). The Analysis of the Government Policy on Technical and Vocational Education and Training (TVET) and the Predicaments of TVET in Malaysia. *International Journal of Humanities Technology and Civilization*, 7(1), 53–58. <https://doi.org/10.15282/ijhtc.v7i1.7611>
- Sanwal, T., Rajput, J., Tyagi, M., Yadav, S., Avasthi, S., & Sareen, P. (2024). *The application of AI to the adoption of Green HRM practices*. In *Advances in Higher Education and Professional Development Book Series* (pp. 241–268). IGI Global. <https://doi.org/10.4018/979-8-3693-2956-6.ch010>
- Sern, L. C., Baharom, N., Foong, L. M., Wan Hanim Nadrah, W. M., Islamiah, R. D., & A., A. (2021). Integrating Green Skills into TVET Curricula in Polytechnics Malaysia. *Journal of Technical Education and Training*, 13(3), 15–19.

- <https://doi.org/10.30880/jtet.2021.13.03.002>
- Shafaei, A., Nejati, M., & Yusoff, Y. M. (2020). Green human resource management: A two-study investigation of antecedents and outcomes. *International Journal of Manpower*, 41(7), 1041–1060. <https://doi.org/10.1108/IJM-07-2019-0345>
- Singleton, J. (2025). Artificial Intelligence in Higher Education Accreditation. 269–306. <https://doi.org/10.4018/979-8-3693-7708-6.ch010>
- Solaimani, S. (2024). From Compliance to Capability: On the Role of Data and Technology in Environment, Social, and Governance. *Sustainability*, 16(14). <https://doi.org/10.3390/su16146061>
- Stella, O. K., Ahmed, F., & Simon, W. (2022). TVET Institutions and Industry Collaborative Practices on Electronics Laboratory Training for Skill Acquisition among Technician Trainees in Kenya. *Journal of Scientific Research and Reports*, 28(9), 1–6. <https://doi.org/10.9734/jsrr/2022/v28i930542>
- Subrahmanyam, S. (2025). *Developing green skills for sustainable careers*. In *Advances in Computational Intelligence and Robotics Book Series* (pp. 101–126). IGI Global. <https://doi.org/10.4018/979-8-3373-1142-5.ch005>
- Suhendra, T., Subagiyo, L., & Basir, A. (2025). *Development of a Guidebook for Green Skills Implementation in Vocational Schools to Support Green Economy Transformation*. *Edunesia* 6(2), 678–693. <https://doi.org/10.51276/edu.v6i2.1151>
- Teh, H. (2024). Rationales and factors influencing universities' engagement with sustainability: an exploration of two Malaysian universities from stakeholders' perspectives. *Journal of Contemporary East Asia Studies*, 13(1), 192–217. <https://doi.org/10.1080/24761028.2025.2471624>
- Thevathas, V. A., & Zakaria, A. binti. (2024). Relationship Between The Importance of Technical and Vocational Education and Training (TVET) Programmes and its Contributions towards Sustainability of Society's Development among Kuala Lumpur Technical Secondary Students. *International Journal of Academic Research in Business and Social Sciences*, 14(7), 331–343. <https://doi.org/10.6007/ijarbss/v14-i7/21057>
- UNESCO. (2020). *Global Education Monitoring Report 2020: Inclusion and education – All means all*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000374802>
- Yazdanian, R., Lee Davis, R., Guo, X., Lim, F., Dillenbourg, P., & Kan, M. Y. (2022). On the radar: Predicting near-future surges in skills' hiring demand to provide early warning to educators. *Computers and Education: Artificial Intelligence*, 3(August 2021), 100043. <https://doi.org/10.1016/j.caeai.2021.100043>
- Yeo, A. C. M., Lim, C. Y., Tay, L. C., & Chin, M. Y. (2025). Establishing an Integrative Sustainability Framework for Higher Education in Malaysia: Economic and Eesg Aspects. *Quantum Journal of Social Sciences and Humanities*, 6(1), 218–236. <https://doi.org/10.55197/qjssh.v6i1.602>
- Zhao, W. (2024). *Innovation and practice of talent cultivation models in higher education from the perspective of industry-education integration*. <https://doi.org/10.62381/h241515>
- Zulkarnaini, N. A. S., Samsuden, N. S., Fong, S.-F., & Sambath, V. (2025). A Systematic Literature Review on Transforming HR Practices for ESG Integration: The Role of Artificial Intelligence in Shaping Sustainable Business Strategies. *International Journal of Research and Innovation in Social Science*, IX(VII), 5092–5104. <https://doi.org/10.47772/IJRIS.2025.907000411>