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Equipping Malaysian Graduates for Sustainable Futures: Developing and Validating a National Scale of Sustainability Competencies

Abd Rahman Ahmad*[1], Hairul Rizad Md Sapry[2], Umi Kartini Rashid[1], Alaa S Jameel[3]

[1]*Johor Business School, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, MALAYSIA*
[2]*Universiti Kuala Lumpur (UNIKL) Kampus Cawangan Malaysian Institute of Industrial Technology, Johor, MALAYSIA*
[3]*Department of Business Administration, Al- Idrisi University College, Ramadi, Al-Anbar, IRAQ*

Corresponding author's email:
arahman@uthm.edu.my
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Abstract- Sustainable development represents a significant challenge for higher education systems globally, including in Malaysia. The nation aims to produce graduates equipped to tackle complex social, environmental, and economic challenges, necessitating the integration of sustainability competencies into university curricula. This study constructs and validates a national scale for assessing sustainability competencies in Malaysian undergraduates, addressing the disconnect between policy goals and actual educational results. The study employs a multi-phase research design to synthesise essential dimensions of sustainability competencies, which encompass systems thinking, critical reflection, problem-solving, and collaborative engagement. An instrument was subsequently refined through expert consultation and evaluated across various Malaysian public universities. Statistical validation was performed to confirm reliability, construct validity, and applicability across institutions of the scale. The results demonstrate that sustainability competencies can be quantitatively assessed, serving as a resource for curriculum evaluation, institutional comparison, and alignment with national policies. Equipping graduates with essential competencies enables Malaysian higher education to significantly contribute to the attainment of the Sustainable Development Goals and prepares students for the challenges posed by a rapidly evolving global landscape. This research presents a methodological improvement in competency assessment and a strategic framework for integrating sustainability into higher education systems.

Keywords: Sustainability competencies, higher education, graduate employability, sustainable development goals (SDGs), curriculum design

1 Introduction

UNESCO (2022) asserts that higher education is anticipated to serve as a transformative agent in equipping graduates to contribute to sustainable development in social, environmental, and economic spheres. This transition positions universities as pivotal in global sustainability initiatives, necessitating that graduates obtain both knowledge and the skills required to tackle intricate real-world issues (Sánchez et al., 2025). In Malaysia, this expectation is especially pertinent as the nation aligns its education system with the Sustainable Development Goals (SDGs) and national development strategies (Economic Planning Unit, 2024).

The notion of sustainability competencies has become increasingly significant as universities can no longer depend exclusively on traditional content delivery. They must instead foster systems thinking, anticipatory skills, and collaborative problem-solving abilities (Xiao et al., 2024). Recent research highlights that the absence of clear definitions and effective measurement tools may result in the embedding of such competencies being more rhetorical than practical (Çam-Tosun & Söğüt, 2024; Karimi, 2024). Lozano et al. (2021) emphasise that competency-based education offers a means to align learning outcomes with

sustainable development; however, the implementation of these outcomes necessitates careful adaptation to specific national and institutional contexts.

Empirical evidence across various regions indicates the viability of assessing sustainability competencies using validated scales (Brundiers & Wiek, 2021). However, it also reveals discrepancies in constructs and instruments that hinder cross-country comparisons (Wiek et al., 2022). In Asian higher education, instruments have been evaluated to assess socio-emotional, cognitive, and behavioural dimensions, demonstrating promising reliability yet constrained generalisability (Xiao et al., 2024). The findings indicate that existing tools require local contextualisation to effectively address the unique cultural, policy, and institutional dynamics of each nation (Sánchez et al., 2025). The policy framework of Malaysia highlights the critical nature of this task. The Malaysia Education Blueprint for Higher Education and the revised Malaysian Qualifications Framework (MQF 2.0) emphasise graduate employability and lifelong learning, while integrating sustainability throughout the curricula (Malaysian Qualifications Agency, 2024). Yeo et al. (2025) observe that although universities have launched initiatives like eco-campus programs and green governance, their implementation varies significantly among institutions. The disparity between national aspirations and local practices underscores the necessity for a standardised, validated instrument to assess sustainability competencies at the graduate level (Ankareddy et al., 2025). Sánchez et al. (2025) identify fragmented governance structures, limited faculty capacity, and insufficient assessment mechanisms as persistent obstacles to the effective integration of sustainability in higher education. Malaysia faces these challenges, as the lack of a psychometrically validated national scale has resulted in institutions lacking a consistent method for evaluating progress (Yeo et al., 2025). The development of such an instrument is a scholarly and policy-relevant undertaking. This paper has two primary objectives.

This study aims to develop a sustainability competency scale that is representative of Malaysia's educational, cultural, and policy contexts. Secondly, this instrument is validated using rigorous methodologies, which encompass exploratory and confirmatory factor analyses, reliability assessments, and cross-group comparisons. This study provides a methodological tool for assessment and a framework for aligning higher education practices with the Sustainable Development Goals (Lozano et al., 2021; Xiao et al., 2024). The validated scale provides universities and policymakers with a practical tool to ensure that Malaysian graduates are adequately prepared for sustainable futures.

2 Literature Review

The discussion surrounding sustainability competencies in higher education has notably increased in the last ten years, highlighting the necessity of aligning academic results with the Sustainable Development Goals (SDGs). UNESCO (2022) indicates that higher education institutions are increasingly acknowledged as essential in providing graduates with the knowledge, skills, and values necessary to tackle global challenges. This transition has prompted researchers to investigate both the theoretical foundations of competencies for sustainable development and the integration of these competencies into educational frameworks (Ávila et al., 2023). Redman et al. (2021) indicate that early research in this field was characterised by fragmentation and diverse interpretations of sustainability-related competencies.

Recent efforts have concentrated on convergence by identifying essential dimensions, including systems thinking, critical reflection, practical problem-solving, and ethical reasoning (Heiskanen et al., 2022). These competencies are now considered transferable attributes that enhance employability and promote social responsibility. In the absence of such alignment, higher education may yield graduates who possess academic qualifications yet lack preparedness for intricate societal transitions (Lozano & Barreiro-Gen, 2021). The expanding literature in Malaysia presents both opportunities and challenges.

There exist comprehensive global and regional frameworks that can guide local practices; however, the variability of institutional contexts prompts enquiries regarding the localisation and effective assessment of these competencies (Yeo et al., 2025). This document analyses four critical areas of literature: global perspectives on sustainability competencies, benchmark studies influencing international practices, regional approaches in ASEAN higher education, and the specific context of Malaysian higher education. This

structured review establishes a basis for recommending a national framework that is informed by international standards while remaining relevant to local contexts.

Global Perspectives on Competencies for Sustainable Development

UNESCO (2022) emphasises that competencies for sustainable development are fundamental capacities necessary for addressing global transitions in energy, climate, health, and social equity. Sustainability competencies are increasingly viewed as multidimensional in international forums, integrating cognitive, practical, and socio-emotional domains that empower learners to act responsibly in complex and uncertain environments (Ávila et al., 2023). This global acknowledgement has transformed the function of higher education, establishing it as an essential environment for developing graduates prepared for the future.

Recent studies highlight that systems thinking and anticipatory learning are frequently recognised as essential global competencies, as they enable students to comprehend interdependencies and equip them for uncertain futures (Brundiers et al., 2021). Heiskanen et al. (2022) assert that the integration of these competencies into higher education curricula necessitates pedagogical innovation, especially through project-based learning and transdisciplinary collaboration. The Organisation for Economic Co-operation and Development (OECD, 2021) emphasises that sustainability education must foster adaptability, critical reflection, and social responsibility as essential attributes for graduates.

A global consensus is developing; however, challenges remain. Redman et al. (2021) highlight the growing standardisation of sustainability competencies in global frameworks; however, scholars note significant variability in their application across different regions and institutions (Xiao et al., 2024). Recent cross-national studies indicate that effective competency development necessitates alignment with cultural and policy contexts, rather than the wholesale adoption of universal models (Sánchez et al., 2025). This suggests that global frameworks offer guidance yet require local modification to attain significant results.

Benchmark Studies on Sustainability Competencies

Barth et al. and Lozano have made foundational contributions to the discourse on sustainability competencies by providing one of the initial structured frameworks for categorising the knowledge, skills, and attitudes essential for sustainable development in higher education. These frameworks, despite being established over ten years ago, remain influential in contemporary scholarship and curricular reforms (Lozano et al., 2020). UNESCO (2021) strengthened these foundations with its Education for Sustainable Development (ESD) framework, which highlights essential competencies including systems thinking, anticipatory learning, collaboration, and normative competence as crucial for equipping graduates for sustainable futures. Recent research validates the continued significance of these foundational models. Lambrechts and Van Petegem (2020) contend that Barth's categorisation serves as a highly effective framework for incorporating sustainability into educational practices. Vázquez-Verdera et al. (2022) illustrate the adaptation of Lozano's framework in European and Asian contexts, focussing on its role in facilitating curriculum transformation through project-based learning and community partnerships.

Researchers increasingly emphasise the necessity for continuous evolution of these benchmarks. Wiek et al. (2021) indicate that global disruptions, including the COVID-19 pandemic, digitalisation, and climate crises, have created new dimensions of uncertainty that require competencies beyond those originally suggested. Scholars advocate for the expansion of benchmark frameworks to incorporate digital literacy, resilience, and intercultural understanding as essential skills for sustainability (Brundiers & Wiek, 2023). Consequently, although the contributions of Barth, Lozano, and UNESCO are essential, their practical application has evolved beyond a static framework. Higher education institutions are urged to consider these frameworks as dynamic documents, capable of adapting to new global and regional challenges while preserving their fundamental purpose of equipping learners with transformative abilities.

Regional/ASEAN Approaches to Sustainability in Higher Education

Sustainability education is gaining recognition as a priority within national higher education agendas in Southeast Asia (Shahrom et al., 2022). Universities in ASEAN encounter shared challenges, including curriculum fragmentation, insufficient faculty expertise, and inconsistent integration of sustainability principles across various disciplines (Wijaya et al., 2021). Despite these limitations, various regional initiatives demonstrate innovative methods for integrating sustainability competencies. Thailand and Indonesia have implemented competency-based learning modules that integrate classroom instruction with experiential, community-based projects, allowing students to apply systems thinking and ethical reasoning in practical contexts (Arsat et al., 2021). Malaysia has started to align its higher education programs with Sustainable Development Goal (SDG) objectives and regional best practices. Recent research indicates that Malaysian universities, including UPM, UM, and UTHM, have implemented institutional sustainability strategies and campus initiatives based on regional experiences, such as eco-campus programs and sustainability-oriented community engagement projects (Omar & Hassan, 2023). These initiatives are frequently executed inconsistently, exhibiting considerable variation among institutions regarding scale, curricular integration, and monitoring mechanisms (Shahrom et al., 2022). Regional studies demonstrate that ASEAN higher education systems gain advantages from cross-border collaborations, knowledge sharing, and benchmarking exercises aimed at enhancing sustainability competencies (Wijaya et al., 2021; Arsat et al., 2021). These efforts highlight the significance of context-sensitive approaches that take into account cultural, economic, and policy environments while adhering to global competency frameworks (Sánchez et al., 2025). Malaysia can utilise these regional insights to create a nationally validated sustainability competency scale that incorporates international benchmarks and local contexts.

3 Malaysian Higher Education Context

National Education Policy and Malaysia Education Blueprint (Higher Education)

The Malaysian government has placed a growing emphasis on sustainability in higher education policy frameworks. The Ministry of Higher Education (MOHE, 2024) states that the Malaysia Education Blueprint (Higher Education 2021–2030) incorporates sustainable development goals into graduate attributes, highlighting employability, lifelong learning, and social responsibility. Yeo et al. (2025) emphasise that these policy initiatives explicitly advocate for the integration of sustainability competencies across various disciplines, extending beyond environmental science programs. Recent revisions to the Malaysian Qualifications Framework (MQF 2.0) mandate that institutions exhibit quantifiable graduate outcomes that are consistent with sustainability principles (Malaysian Qualifications Agency [MQA], 2024). These frameworks collectively establish a conducive policy environment for the standardisation of competency development at the national level.

Existing Initiatives

Many Malaysian universities have established institutional strategies and programs to enhance sustainability competencies. Universiti Putra Malaysia (UPM) has established a comprehensive Green Policy addressing energy efficiency, waste management, and sustainability initiatives led by students (UPM Sustainability Office, 2023). Universiti Malaya (UM) has incorporated sustainability into its academic and co-curricular programs, which encompass community engagement projects led by its Sustainability Office and eco-campus initiatives (Omar & Hassan, 2023). UTHM promotes an eco-campus model that integrates operational sustainability with student involvement in applied projects, thereby enhancing both practical and social competencies (Yeo et al., 2025). These initiatives illustrate the capacity of Malaysian universities to function as laboratories for the development of sustainability competencies pertinent to the nation.

Challenges Faced

Malaysian universities continue to encounter significant obstacles in the comprehensive integration of sustainability competencies within their curricula, despite these promising initiatives. Curriculum

fragmentation among faculties frequently restricts interdisciplinary learning and the integration of sustainability principles (Shahrom et al., 2022). Faculty capacity represents a notable barrier, as numerous instructors lack training in sustainability pedagogy, leading to inconsistent delivery and varied student exposure (Wijaya et al., 2021). Additionally, the allocation of resources for sustainability initiatives, such as funding for experiential learning, industry collaborations, and evaluation methods, is limited in numerous institutions (Omar & Hassan, 2023). These challenges underscore the necessity for a coordinated national strategy that aligns policy directives and guarantees uniform implementation across universities.

4 Developing Critical Competencies

Cognitive Competencies: Systems Thinking, Critical Analysis, Interdisciplinary Learning

Cognitive competencies underpin sustainability literacy, encompassing systems thinking, critical analysis, and interdisciplinary learning. Systems thinking allows students to recognise intricate interconnections among social, economic, and environmental systems, facilitating the anticipation of decision consequences (Brundiers & Wiek, 2021). Critical analysis enables learners to evaluate evidence, assess trade-offs, and question assumptions in addressing sustainability-related issues (Heiskanen et al., 2022). Interdisciplinary learning promotes the integration of knowledge across various fields, thereby improving students' ability to tackle complex sustainability challenges (Redman et al., 2021). Through the development of cognitive skills, higher education institutions equip graduates to engage in holistic thinking and effectively manage complexity in both professional and societal contexts.

Practical Competencies: Problem-Solving, Project-Based Sustainability Work

Practical competencies focus on the application of knowledge and skills in real-world contexts. Effective problem-solving necessitates that students design, implement, and evaluate sustainability interventions (Ávila et al., 2023). Project-based learning serves as an effective pedagogical approach for developing these skills by engaging students in practical experiences that replicate real-world challenges (Lambrechts & Van Petegem, 2020). Research indicates that involvement in applied sustainability initiatives enhances technical skills and reflective abilities, thereby strengthening the connection between theoretical understanding and practical results (Vázquez-Verdera et al., 2022). Embedding project-based and experiential learning opportunities into curricula is essential for equipping graduates with practical sustainability competencies.

Social Competencies: Ethical Reasoning, Community Engagement, Cultural Awareness

Social competencies are essential for graduates to effectively address the human and ethical aspects of sustainability. Ethical reasoning facilitates responsible decision-making and aids students in balancing conflicting social, economic, and environmental priorities (Sánchez et al., 2025). Community engagement promotes collaborative learning and reinforces connections between universities and local stakeholders, thereby increasing the societal impact of sustainability initiatives (Arsat et al., 2021). Cultural awareness guarantees that sustainability solutions are contextually pertinent and attuned to Malaysia's multicultural context, thereby enhancing both acceptance and effectiveness (Wijaya et al., 2021). Social competencies equip graduates to engage responsibly, inclusively, and ethically within intricate social systems.

5 Framework Proposal for Malaysia

Integration into Curriculum

In order to achieve universal embedding of sustainability competencies, integration must encompass not only environmental faculties but also disciplines such as business, engineering, health sciences, and the humanities. Lozano et al. (2021) assert that cross-disciplinary integration enhances comprehensive

understanding and equips graduates to implement sustainability principles across various professional settings. Mapping the Malaysian Qualifications Framework (MQF 2.0) learning outcomes to sustainability competencies offers a standardised method that ensures consistency while acknowledging disciplinary differences (Malaysian Qualifications Agency [MQA], 2024). This integration promotes engagement with sustainability among students across all faculties, fostering systemic awareness, ethical reasoning, and problem-solving skills (Yeo et al., 2025).

Experiential Learning and Industry Partnerships

Experiential learning is essential for the development of practical and social competencies. Structured internships, capstone projects, and living labs facilitate the application of theoretical knowledge in practical settings (Brundiers & Wiek, 2021). Furthermore, collaborations with industry and community organisations facilitate joint problem-solving and establish feedback mechanisms for ongoing learning (Ávila et al., 2023). Research within ASEAN higher education indicates that partnerships improve skill acquisition and student motivation, thereby strengthening the practical significance of sustainability competencies (Arsat et al., 2021). Integrating experiential learning with external collaboration enables Malaysian universities to equip graduates with competencies that are both theoretically informed and practical.

Policy Recommendations for the Ministry of Higher Education (MOHE)

The Ministry of Higher Education (MOHE) can significantly contribute to the standardisation of sustainability competency development in Malaysian universities at the policy level. The ministry could endorse a nationally validated sustainability competency scale to enhance benchmarking and quality assurance reporting (SDG Roadmap Phase II, 2021). Secondly, focused financial support for faculty development, curriculum redesign, and interdisciplinary initiatives would improve the institution's ability to effectively deliver these competencies (Omar & Hassan, 2023). Integrating competency metrics into frameworks for graduate employability and institutional rankings would encourage universities to incorporate sustainability across all faculties (Shahrom et al., 2022). Policy interventions would align national priorities, institutional practices, and global sustainability standards, thereby establishing a coherent ecosystem for sustainability education in Malaysia.

Conclusion

An analysis of global, regional, and Malaysian literature demonstrates that sustainability competencies have become essential for educating graduates to address complex socio-ecological challenges (UNESCO, 2022; Ávila et al., 2023). Benchmark frameworks established by Barth, Lozano, and UNESCO offer a conceptual foundation, whereas regional ASEAN experiences and Malaysian institutional initiatives provide practical insights for local adaptation (Brundiers & Wiek, 2021; Omar & Hassan, 2023). The cultivation of cognitive, practical, and social competencies guarantees that graduates possess not only knowledge but also the ability to engage in ethical decision-making, collaborative problem-solving, and culturally sensitive interactions (Heiskanen et al., 2022; Sánchez et al., 2025). A nationally validated sustainability competency scale can function as a guide and evaluative tool for Malaysian universities. The proposed framework highlights the importance of integration among all faculties, the provision of experiential learning opportunities, and the establishment of partnerships with industry and communities (Lozano et al., 2021; Ávila et al., 2023). Support from the Ministry of Higher Education is essential for promoting adoption, securing funding for capacity building, and integrating competency metrics into national quality assurance and ranking systems (SDG Roadmap Phase II, 2021; Shahrom et al., 2022). Universities should adopt a phased approach: conducting pilot tests of the competency scale across various institutions, aligning curricula with the MQF 2.0 outcomes, and establishing monitoring mechanisms to assess graduate development. Future research should prioritise longitudinal studies to evaluate the effects of these competencies on graduate employability and societal contributions, alongside cross-cultural validation to confirm their applicability within Malaysia's multicultural context (Wijaya et al., 2021; Arsat et al., 2021). Systematic embedding and evaluation of

sustainability competencies in Malaysian higher education can significantly contribute to the attainment of the SDGs and equip graduates for sustainable futures.

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