عدد خاص بالندوة العلمية الدولية التعليم الأخضر مسار استراتيجي للتنمية المستدامة ليبيا
2026-6/16-14
الهيئة الليبية للبحث العلمي
المركز الليبي لأبحاث التنمية المستدامة

مجـــلة الفـــاروق للعلـــــوم
المجلـــد (2) العـدد 4 يونيـــو 2026
Al-Farooq Journal of Sciences
Volume (2) Issue (4) June2026
Issn3135-2359

Integrating Green Pedagogy and Sustainability into Libyan Higher Education Curricula: Are We Heading in the Right Direction?

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تاريخ الاستلام: 2026/04/01 تاريخ المراجعة 2026 /04/30 تاريخ القبول:2026/05/13- تاريخ النشر: 2026 /06/16

Abstract

The need for more sustainable communities has developed locally, nationally, and globally in this era of limited resources that are contending with increasing population expansion and economic development. Education has long been seen as a path for integrating and advancing sustainable development goals at all stages of the educational system by reorienting the curriculum toward sustainability. In this process, higher education institutes assume a leadership role. However, integrating sustainability into curricula and enhancing students' competences in sustainability are two of the biggest challenges facing Libyan higher education institutions where students need to be prepared to face the difficulties of creating a more sustainable society with the support of Education for Sustainability (ES). But before achieving this aim, instructors may consider adoptive frameworks of green pedagogy to integrate ES into their curricula. This paper discusses the importance of incorporating sustainability into university courses, how to integrate it, and the difficulties that instructors might face. It is concluded that the integration of sustainability into educational approaches is considered a crucial issue in Libyan higher education. Giving students the knowledge, understanding, and skills that they need to succeed as well as cultivating the next wave of innovators and leaders can potentially bring the change that is required and have a significant impact on the transition to a sustainable future.

Key words: Education for sustainability, experiential learning, Green Pedagogy, Higher education, STEAM

دمج التعليم الاخضر والاستدامة في مناهج التعليم العالي الليبية: هل نسير في الاتجاه الصحيح؟

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المستخلص

تزايدت الحاجة إلى مجتمعات أكثر استدامة على المستويات المحلية والوطنية والعالمية في عصر محدودية الموارد، في ظل النمو السكاني المتزايد والتنمية الاقتصادية. لطالما نُظر إلى التعليم كسبيل لدمج أهداف التنمية المستدامة والنهوض بها في جميع مراحل النظام التعليمي، وذلك من خلال إعادة توجيه المناهج الدراسية نحو الاستدامة. وفي هذا السياق، تضطلع مؤسسات التعليم العالي بدور ريادي. ومع ذلك، يُعدّ دمج الاستدامة في المناهج الدراسية وتعزيز كفاءات الطلاب في هذا المجال من أكبر التحديات التي تواجه مؤسسات التعليم العالي الليبية، حيث يحتاج الطلاب إلى الاستعداد لمواجهة صعوبات بناء مجتمع أكثر استدامة بدعم من التعليم من أجل الاستدامة. ولكن قبل تحقيق هذا الهدف، قد ينظر المدرسون في تبني أطر التربية الخضراء لدمج التعليم من أجل الاستدامة في مناهجهم الدراسية. تناقش هذه الورقة البحثية أهمية دمج الاستدامة في المقررات الجامعية، وكيفية دمجها، والصعوبات التي قد يواجهها المدرسون. وتخلص إلى أن دمج الاستدامة في المناهج التعليمية يُعدّ قضية بالغة الأهمية في التعليم العالي الليبي. إن تزويد الطلاب بالمعرفة والفهم والمهارات التي يحتاجونها للنجاح، بالإضافة إلى تنمية الجيل القادم من المبتكرين والقادة، يمكن أن يُحدث التغيير المطلوب ويكون له تأثير كبير على الانتقال إلى مستقبل مستدام

الكلمات المفتاحية:التعليم من أجل الاستدامة، التعلم التجريبي، التعليم الأخضر، التعليم العالي، والعلوم والتكنولوجيا (STEAM)

1.Introduction

The United Nations approved 17 sustainable development goals (SDGs) in 2015 with the intention of addressing a range of social, economic, and environmental issues by 2030, such as environmental degradation, poverty, inequality, and climate change, as well as peace and justice. By incorporating the SDGs into higher education, students are given the knowledge and analytical skills necessary to understand how social, economic, and environmental concerns are interconnected. Students get a sense of civic responsibility, empathy, and cultural knowledge by solving real-world problems. These qualities are essential for building an equitable and sustainable world, (Camacho, et al, 2019).

This paper discusses the role of higher education on Libya's attainment of the Sustainable Development Goals. This is significant since earlier research has focused on the contributions made by the social science and engineering fields to the accomplishment of the SDGs, but less is known about the contribution made by the arts and education colleges, (Tasiopoulou et al.2020). Therefore, this paper helps to offer precise information about how education institutes help to effectively fulfil the SDGs and leads for better understanding and investigation of the significant contribution that higher education makes to the attainment of the sustainable development objectives by students, teachers, researchers, and policy makers. Specifically, this paper argues that arts and education colleges can best fulfil this role by transitioning toward green pedagogy operationalized through experiential learning and integrated STEAM frameworks thereby equipping pre-service educators with practical tools to green their future classrooms.

Furthermore, there is a worldwide call for adjusting the educational process by integrating the values and principles of sustainable development. Consequently, this might help to solve the twenty-first century cultural, environmental and social issues, (Aramburuzabala & Cerrillo, 2023). This change in viewpoint is expected to inspire instructors and professionals in all domains to keep creating teaching strategies and resources for sustainable growth. In addition, the integration and functioning of the social, cultural, economic, political, and ecological systems of which they are a part must also be understood by students, (Hale et al., 2017).

2.Literature review

2.1What is sustainability

According to Blewitt (2015), sustainable development is a framework for achieving human development goals while maintaining natural systems' capacity to deliver ecosystem services and natural resources that are essential to the health of the economy and society. By 2030, the Sustainable Development Goals seek to create a more equal and sustainable world by tackling a wide range of social, economic, and environmental issues. Key issues like poverty, hunger, health, education, gender equality, affordable and clean energy, clean water, decent work, responsible consumerism, climate action, and more are covered by these goals. In order to advance social inclusion, economic growth, and environmental protection while leaving no one behind, the Sustainable Development Goals (SDGs) offer a framework for global cooperation and action. According to (Dukanwojo 2023: 2166-2167) Goals for Sustainable Development (SDGs) comprise:

- No poverty -Zero hunger -Good health and wellbeing
-Quality education -Gender equality -Clean water and sanitation
-Affordable and clean energy -Decent work and economic growth
-Industry, innovation and infrastructure -Reduced Inequalities
- Sustainable cities and communities -Responsible consumption and production
-Climate action -Life below water -Life on land
-Peace, justice and strong institutions -Partnerships for the goals.

2.2 Education and sustainable development

Through the promotion of social, economic, and political reform, Education for Sustainable Development (ESD) aims to train people to address the issues associated with sustainable development (Leicht et al., 2018). Therefore, one of UNESCO's main goals was to emphasize the critical role that education can play in promoting healthy lifestyles for both the present and the future generations, as well as the need of protecting and developing both natural and human heritage as one of humanity's greatest challenges, (Fronza & Velazquez, 2020).

A great deal of research has emerged connecting education to the long-term realization of sustainable development, particularly with reference to education's capacity to promote sustainable personal behaviours and values (UNESCO, 2016). These days, there is a global focus on the crucial role that educators and educational institutions play in achieving sustainable education, (Timm & Barth, 2020). The importance of education for sustainable development is becoming more widely recognized on a global scale, and institutions are actively working to see that role played in increasing numbers. Education raises literacy rates and encourages the dissemination of knowledge.

Formal education, which equips students with a set of abilities that connect to the humanities, sciences, and general critical thinking, is one of the most important ways that schools shape the citizens of the future. According to Camacho, et al, (2019), theories and behaviours related to sustainability can also be promoted through education. It increases students' sense of duty towards their natural surroundings by raising their understanding of human-ecosystem interactions and improving their environmental consciousness. This will help them understand and face a constantly changing global reality.

However, innovation in education can be accelerated and educational methods enhanced by sustainability. Its holistic and interdisciplinary approach can promote collaboration between academic disciplines and educational establishments. Teaching about sustainability in the classroom can assist teachers in better preparing their students for the opportunities and challenges that lie ahead, (Fronza & Velazquez, 2020).

2.3 The importance of integrating Sustainability in higher education

Academics concur that education is essential for promoting the development of sustainable practices. According to UNESCO (2005), education can help students develop into civically involved individuals who respect social equality, environmental stewardship, and tolerance. Without adequate information, children are unable to completely comprehend the negative effects that particular decisions have on the environment. Therefore, there is a favourable correlation between environmental literacy and proactive behaviour, environmental conservation, and engaged citizenry. This demonstrates how supporting sustainability practice requires a grasp of sustainability science (Peer et al., 2007).

Formal education can reverse this tendency by encouraging a critical awareness of nature, which in turn encourages sustainable behaviours and places an emphasis on the responsible use of environmental resources. This can be accomplished by calling various subjects to action, (Timm & Barth, 2020). Thus, education may essentially promote harmonious interactions between people and their environment by forming critical knowledge of the numerous issues raised by climate change and environmental degradation as well as good attitudes toward nature protection. Thus, educating students about environmental and social awareness benefits society beyond the classroom as it equips the next generation with knowledge, resources, and experience needed to comprehend a complex and interconnected global reality, (Hale et al., 2017).

In actuality, civic education, which now incorporates sustainable practices has long been supported by school instruction (Carney, 2012). This function is especially important when the general public has a mistrust of science and feels helpless to address the complex societal issues

that humanity faces, (McFarlane & Ogazon, 2011). Education can promote understanding of the relationship between societies and nature, as well as the significance of safeguarding the latter for social wellbeing, by implementing a pedagogy of (strategic) responsibility (UNESCO, 2012). Examining variety, human behaviour, and the exploitation of natural resources are a few examples of practices of responsibility. This daily classroom observation can be extended to the larger society, (Fronza & Velazquez (2020).

Classroom promoted transformative learning processes enable students and instructors to innovate and foster a closer relationship with nature. As a result, students who understand the importance of sustainability concerns at school, for instance, might use this knowledge to benefit their community. Schools, as micro-societies, can serve as centres for the development of sustainability agents that are aware of concerns like cultural sensitivity, animal conservation, and quality of life (Carney, 2012). These change agents can then persuade those who live nearby to adopt more environmentally friendly habits. Therefore, education for sustainability fosters a sustainable culture that may spread to more societal levels and is characterized by concern for the community and the environment, (Fronza & Velazquez (2020).

2.4 The challenges of integrating sustainability in higher education

Integrating sustainability into higher education curricula presents a formidable challenge due to its complexity and the substantial time commitment required. The complexity arises from the multifaceted nature of sustainability itself, encompassing environmental, social, and economic dimensions, (Waas et al, 2012). Furthermore, according to Dukanwojo (2023), the time-consuming aspect stems from several factors: 1) Curriculum Development: most of the available teaching materials and resources are not adequate for the inclusion of the SDGs. This requires designing new courses or revising existing ones to incorporate sustainability learning outcomes which demands significant effort from educators and policy makers, including research, material selection, and pedagogical innovation as the current teaching/learning methods does not support the implementation of the sustainable development goals. 2) Faculty Training: some educators are not trained to teach the SDGs and incorporate them into their teaching practice. Thus, educators may need professional development opportunities to adequately address sustainability topics. 3) Resource Allocation: Implementing sustainability initiatives within curricula often requires resources, including funding for materials and technology. 4) Assessment and Evaluation: Developing robust methods to assess students' understanding and application of sustainability principles adds another layer of complexity and time.

Furthermore, Wass, et al (2012) mentioned the following challenges that higher education institutions encounter in working toward sustainability: 1) Disciplinary organizational structures impede collaborative learning and integrative thinking 2) Sustainability is not considered an essential component of higher education curricula, but rather as an add-on. 3) Higher education decision makers lack a clear vision of sustainability. 4) Insufficient knowledge of sustainability, awareness about its importance in higher education. 5) Lack of common understanding of sustainability among educators and policy makers. 6) lack of motivation to integrate sustainability in the higher education curricula. 7) Sustainability is conceived as irrelevant to the academic courses and research. 8) Insufficient financial resources and lack of clear vision about the essential resources to implement sustainability. 9) Threat to educators' and researchers' academic credibility.

2.5 How to integrate sustainability in higher education

The literature on education for sustainable development calls for pedagogical innovations that provide interactive, transformative, and real-world learning in order to stimulate critical and systemic thinking in the context of sustainable development. Fronza & Velazquez (2020)

mentioned the following green pedagogy frameworks that might help to integrate sustainability in the classrooms:

2.5.1 STEAM

A multi-perspective approach and interdisciplinary thinking linking ideas and knowledge from various academic traditions, such as science, history, geography, cultural diversity, or human rights, are necessary for education and sustainability (UNESCO, 2012). One example of this integration is STEAM, which was characterized as the confluence of science, art, and aesthetics. According to Clark and Button (2011), the STEAM method aids in reinforcing students' comprehension of socio-environmental links and the effects of human activity on the natural world. Students became more conscious of environmental (in)justice and eager to support sustainability as a result.

According to Tasiopoulou et al. (2020), STEM education must be integrated to improve our lives and meet the demands of the future. Every element of S (science) must cooperate with one another. To work together, all the letters in STEM. It would be even better if all the topics collaborated, turning STEM and STEAM into STE(A)M. When it comes to teaching sustainability, STE(A)M as an educational model addresses the requirement for being transdisciplinary. Art serves as the link between scientific knowledge and sustainable action in STE(A)M, which improves problem-solving abilities applied to actual societal challenges by bridging the fields of science, technology, engineering, and mathematics.

2.5.2 Experiential Learning

Higher education institutions are tackling sustainability issues in different ways, such as prioritizing sustainable practices, funding research focused on more socially sustainable efforts, actively involving non-university partners in sustainability discussions, and modifying their curricula and teaching methods to integrate sustainability into learning. In order to effectively steer sustainable development and address the needs of local and global communities, universities need to adopt innovative methods such as experiential learning, (Aramburuzabala & Cerrillo, 2023).

Through questioning, investigation, practical experiences, and experimentation, students can address real-world sustainability concerns through two pedagogies that are applicable to both STEAM and place-based education: problem- and project-based learning (Cortese, 2003; Bacon et al., 2011). In addition to fostering active student participation in the learning process, these green pedagogies offer opportunities for students to apply their newly acquired skills to a variety of settings outside of the classroom, (Gras-Velazquez, 2020).

Students can use peer and collaborative learning to generate creative solutions when working on a project or challenge in a group. As a result, these methods foster accountability, interdependence, and group interactions while equipping students with the skills necessary to handle contemporary real-world problems (Laurie et al., 2016). A case in point is community inquiry. Through a case-study approach that combines place-based education and problem-based learning, students can look into local issues. Through this experience, they will gain skills in study design, finding relevant information, and community interaction (UNESCO, 2012). Additionally, project-based learning offers schools and students the chance to directly impact their local communities with measurable results through the projects they participate in.

Service learning (SL) is a form of experiential learning where students participate in activities that benefit communities, and these experiences are carefully designed to help them learn and grow. Service learning shares many main principles with Education for Sustainable Development (ESD), making it a highly suitable pedagogical approach for fostering sustainability in higher education, particularly. These core shared characteristics include a focus on community reciprocity, the integration of local needs with global considerations, the

cultivation of social awareness, and an emphasis on experiential learning. Service learning appears to be an efficient method for teaching sustainability because it involves students in real-world problem-solving and addresses pressing social and global issues, (Mintz, et al 2013).

2.6 The role of university instructors

The approaches listed above are all centred on helping students learn, enhance their skills and raise their awareness. However, a lot of research, emphasis, and prioritization has been placed on instructors' roles as agents of change (O'Brien, 2010). Instructors are typically in the forefront of introducing innovation into the classroom, and their ability to disseminate knowledge and create a stimulating learning environment has a good correlation with students' academic success and engagement (Timm & Barth, 2020). UNESCO (2005) also considers the instructors' role as crucial to promoting education for sustainable development. Consequently, educators' lack of awareness about the importance of the sustainable development goals and their non-willingness to adapt the existing curriculum to accommodate the SDGs might negatively affect the integration of sustainability in their courses. For this purpose, the teachers' knowledge, attitudes, perceptions, actions, practices matter. Zachariou et al. (2017) argue that teachers' attitudes towards sustainability are mainly connected to their actions and decisions to integrate it in their teaching practice. They further suggest that once teachers have sufficient knowledge and positive attitudes towards sustainability, it would be reflected in their courses.

The lack of a clear understanding of sustainability among educators and policy makers is a critical issue that has to be addressed if teachers are to achieve similar objectives in the scope of sustainability as well (O'Brien, 2010). Teachers must be passionate about sustainability and appreciate its need. In addition, teachers need to shift their teaching and learning methods for sustainable development. Consequently, this would equip the students with the essential competencies. According to Wass et al (2012), students should have the knowledge about sustainability, the skills to behave sustainably and the personal values and attitudes to act sustainably.

Educators need to create opportunities for their students to reflect on their own lifestyles and the structures and perspectives that promote those lifestyles. According to Camacho, et al, 2019, 'Education for Sustainable Development (ESD) empowers people to change their way of thinking and to work towards a sustainable future' p.3.

3. Integrating sustainability in higher education: insights from practices

Through a case-study approach, the following section introduces two trials designed and implemented by the author to integrate sustainability into English language courses at Sabratha University, demonstrating how an arts and humanities curriculum practically addresses the UN Sustainable Development Goals. Huot (2024) suggests that English Language Teaching (ELT) can effectively incorporate sustainability and environmental education using methodologies such as content-based instruction, task-based language teaching, and project-based learning to balance language and content instruction. Hammed (2023) further asserts that ELT curricula should adopt constructivist approaches to learning, emphasizing collaborative environments through problem-solving and service learning. In this study, these active methodologies are operationalized as core frameworks of Green Pedagogy. By moving beyond traditional rote lecturing, these two projects from the author's classrooms illustrate how experiential learning and interdisciplinary problem-solving can cultivate both linguistic competence and environmental agency in future educators.

3.1Integrating environmental issues in the EFL writing classroom

The project took place in the College of Arts and Education for fourth year students in an academic writing course. Project based learning was selected because it is an effective method of learning to raise students' awareness about the sustainability and the environmental issues that Libya faces, as well as enhancing their skills and attitudes for citizenship and engagement

in Libyan society. The research involved students working in small groups to write providing solutions to problems essays about how to protect the environment and make their cities more sustainable. After submitting their final drafts, students were involved in focus group discussion to reflect on their work to identify the benefits and challenges of writing about the environment protection as well as to discuss the solutions that they offered in their essays to make their cities more sustainable. Based on the reflection, the students decided to design posters and art crafts to raise their colleagues' awareness about the environmental issues. The findings show that project-based learning allows students to use the English language in context. Furthermore, students favour PBL because it provides a safe environment for all students to share their ideas and learn from one another. Finally, the PBL tasks promoted the students' awareness of environmental sustainability and how to protect it. The findings of this research provide good evidence of the effectiveness of PBL to raise students' awareness and engage them in meaningful learning tasks that enhance their academic and soft skills, (Suwaed, 2022). This research serves as a concrete example of how modern teaching methods (PBL) can be successfully applicable to the topic of sustainability in a Libyan context, moving the discussion from theoretical to practical.

3.2 Incorporating sustainability into the teacher education Programme

This project was trial to integrate environmental sustainability in the teacher education program through teaching methods course. According to UNESCO (2010), teacher education courses are fundamental for transforming society and improving educational sustainability. Consequently, teaching pre-service teachers about environmental and sustainable issues might enhance their social responsibility and pedagogical skills, (Gursoy, 2011). The participants were third year education students. The participants were assigned to select environmental sustainability issues in their micro teaching task. Then, they were encouraged to reflect on their teaching experience. The findings of this study showed that integrating environmental sustainability in the curriculum enhanced the preservice teachers' academic and soft skills, autonomy, and teaching skills. In addition, it helped them realize their social responsibility, and the positive roles that they can play in Libyan society to raise the awareness about sustainability. In this way, teaching experiences such as project work and micro teaching will assist in forming pro-environmental attitudes and behaviours in future language teachers. This highlights the crucial role of teacher training in ensuring long-term, systemic change. This study's findings emphasize the significance of addressing environmental sustainability at all educational levels, (Suwaed, 2024). This shows that the focus is not just on current students but also on building the capacity of future educators, which is a key component of a sustainable education system.

4. Conclusion, Implications and Recommendations

In an era of critical environmental issues that are caused by human activities and collapsing socioeconomic structures that pose a series threat to the wellbeing of human generations, it is commonly recognised that higher education institutions and universities have the moral and ethical obligation to change in order to become a driving force behind societal changes for sustainable development, (Wass et al., 2012).

Higher education programs often neglect the crucial aim of educating for a sustainable society. This might occur because most of their subjects tend to highlight specific skills, and neglect broader competencies. Thus, higher education curricula need to integrate sustainability to prepare students for sustainable lives both personally and professionally, (Aramburuzabala & Cerrillo, 2023).

University-level environmental and sustainability education-based curricula are becoming more and more dominant, preparing teachers for the thrilling task of imparting sustainability education, (Stratton, 2015). Educators might encourage self-assessment, critical thinking, and inquiry in their students as well as the development of transferable and transversal abilities (Leicht et al., 2018). Teachers should be given the opportunity to enhance their sustainability

competences, as suggested by (Timm & Barth 2020), given the necessity of being conversant with themes related to sustainability and pedagogies.

The importance of sustainability and environmental knowledge for university instructors has been supported by a number of published research, (Boon & Wilson, 2011). If educators aim to successfully integrate sustainability into their classrooms, they should recognize the significance of integrating it as well as the benefits of innovative and varied teaching strategies. Effectively teaching of sustainability requires educators to simultaneously achieve two critical understandings. First, they must fully comprehend sustainability's broad and complex scope, moving beyond simplistic definitions to grasp its environmental, social, and economic complexities (Rahm & Gorges, 2018). Second, they must change the traditional model of teaching which simply delivers information to passive students (Clarke et al., 2015). Instead, teaching sustainability demands fostering active engagement, critical thinking, and a hands-on approach. Students need to be empowered to question, analyse, and innovate, rather than just memorize facts, if they are to become effective agents of change for a sustainable future.

According to Aramburuzabala & Cerrillo (2023), making higher education curricula sustainable entails a significant transformation that involves employing green pedagogies that align with sustainable development ideas and fostering deep discussions about intellectual and ethical matters. For example, the two case studies presented showed that teaching approaches that align with sustainability principles include: critical thinking about local and global problems, using dialogue-based methods such as discussions and debates, working together on group tasks and projects, examining hypothetical and real-world scenarios through role-playing and case studies, experiential learning through service learning and community service, and project based learning. The findings of these studies indicated that integrating sustainability in higher education courses has numerous benefits. It aligns universities with global Sustainable Development Goals and prepares students to become future leaders. This approach transforms education by fostering interdisciplinary and applied knowledge, and significantly enhances students' academic and life skills, as well as their content knowledge. The two studies demonstrate that practical efforts are already underway despite the existing challenges.

Teachers need to be aware of the innovative green pedagogy frameworks such as STEAM, experiential learning before they can value and use them effectively in the classroom. Consequently, this involves a readiness to encourage students to consider problems from various angles, which is essential for the growth of sustainability literacy as well as the cultivation of a feeling of place and environmental dynamics (Clarke et al., 2015). For example, Stratton (2015) suggests tying science courses to outdoor education. This way, teachers can give students real-world examples and information while also connecting the latter to sustainability issues, which is fundamental to the creation of a sense of place.

Many instructors may hesitate to integrate sustainability in their courses due to insufficient training and resources. This research, therefore, highlights the need to create new educational materials and update the existing syllabuses. This includes not only developing new textbooks and digital content but also practical case studies, interactive models, and interdisciplinary modules that can bring complex sustainability concepts to life. Simultaneously, there's a pressing need to update the existing educational resources to reflect the latest advancements in environmental science, social equity, and economic sustainability.

Additionally, this research emphasizes the importance of providing pre-service and in-service professional development opportunities for teachers to enhance their content and pedagogical knowledge. This involves creating robust programs for teacher training that equip instructors

with the necessary pedagogical strategies, subject matter expertise, and confidence to integrate sustainability across various disciplines. These programs should aim for knowledge expansion in areas such as climate science, social justice, and ecological literacy. Furthermore, these programs should focus on enhancing teachers' skills to enable them to facilitate engaging discussions, guide problem-based learning initiatives, and empower students to become active participants in creating sustainable solutions. Such comprehensive professional development, tailored to the broad and evolving nature of sustainability, is crucial to fostering a new generation of environmentally conscious and socially responsible citizens.

To translate these empirical findings into systemic reform and address the critical gap in our current educational trajectory, the following actionable recommendations are proposed for embedding green pedagogy and sustainability across Libyan higher education institutions:

For Curricula Design:

- Systematically integrate sustainability and eco-pedagogy into humanities and language departments, rather than leaving environmental education isolated within science faculties.

- Provide adequate instructional materials and resources that support the teaching of the SDGs.

For Instructional Methods:

-Encourage shifting away from traditional, teacher-centred rote memorization toward constructivist, experiential frameworks in undergraduate coursework.
-Foster partnerships with the private sector and the non-governmental organizations to provide support for students to participate in community service initiatives that contribute in achieving the SDGs.

For Teacher Professional Development:

-Provide targeted in-service and pre-service training workshops that show educators how to use modern tools (such as generative AI acting as a pedagogical co-pilot) to efficiently design localized, green lesson plans.
Ultimately, this paper demonstrates that integrating green pedagogy into Libyan higher education is not merely an academic luxury, but a developmental necessity. By utilizing experiential learning and STEAM frameworks within arts and education colleges, institutions can transition from theory to practice. While significant challenges remain, empowering pre-service teachers through localized sustainability projects provides a clear, actionable roadmap proving that with the right methodological shifts, Libyan higher education can indeed head in the right direction toward a sustainable future.

References

Aramburuzabala, P.; Cerrillo, R. (2023) Service-Learning as an Approach to Educating for Sustainable Development. *Sustainability*, 15, 11231, 1-13.
Bacon, C., Mulvaney, D., Ball, T., Dupuis, E., Gliessman, S., Lipschutz, R. & Shakouria, A. (2011). The creation of an integrated sustainability curriculum and student praxis projects. *International Journal of Sustainability in Higher Education*, 12(2), 193–208.
Blewitt, J (2015). Understanding Sustainable Development (2nd Ed.). London: Routledge ISBN Publishers.
Boon, H., & Wilson, K. (2011). Pre-service teachers' preparedness for sustainability education- a case study. In Proceedings of 2010 Australian Teacher Education Association National

Conference in: Teacher Education for a Sustainable Future, 1-12. Australian Teacher Education Association.
Camacho, M. , Martín, M. Fuentes-Loss, M. and CarmenBalaguer-Fàbrega M. (2019) Integrating Sustainability into Higher Education Curricula through the Project Method, a Global Learning Strategy. *Sustainability*. 11, 767, 1-25.
Carney, J. (2011). Teacher candidates learning to teach for sustainability in an elementary school with a garden: A case study. *Journal of Sustainability Education*, 2.
Clark, B. & Button, C. (2011). Sustainability transdisciplinary education model: Interface of arts, science, and community (STEM). *International Journal of Sustainability in Higher Education*, 12(1), 41–54.
Clarke, D. & Mcphie, J. (2015). From places to paths: Learning for Sustainability, teacher education and a philosophy of becoming. *Environmental Education Research*, 22(7), 1002-1024.
Cortese, D. (2003). The critical role of higher education in creating a sustainable future. *Planning for higher education*, 31(3), 15–22.
Dukanwojo, S. (2023). The Role of Social Studies in Achieving the Sustainable Development Goals in Nigeria: An Overview. *International Journal of Social Science and Education Research Studies*, 3(10), 2165-2168.
Fronza, V. & Velazquez, A. (2020) Sustainability in Formal Education: Ways to Integrate it Now. *Innovation in STEM learning*, 1(2), 154-177.
Gras-Velazqez, A. (2020). Project-Based Learning in Second Language Acquisition. Building Communities of Practice in Higher Education. Routledge.
Hale, A. , Shelton, C., Ritcher, J., & Archambault, L. (2017). Integrating geoscience and sustainability: Examining socio-techno-ecological relationships within content designed to prepare teachers. *Journal of Geoscience Education*, 65(2), 101–112.
Hameed, A. (2023) Environmental Concerns and English Language Teaching in Saudi Context: Perceptions and Practices. *Journal of Language Teaching and Research*. 14(4), 1127-1137.
Huot, S. (2024) Integrating English Language Teaching with Environmental Sustainability: A Comprehensive Review of Pedagogical Strategies and Global Impacts. *AU Journal of Entrepreneurship and Green Innovation*. 1(2), 1-14.
Laurie, R., Nonoyama-tarumi, Y., Mckeown, R. & Hopkins, C. (2016). Contributions of education for sustainable development (ESD) to quality education: A synthesis of research. *Journal of Education for Sustainable development*, 10(2), 226–242.
Leicht, A., Heiss, J., & Byun, W. (2018). Issues and trends in education for sustainable development (5). UNESCO Publishing.
Alnnale, T. (2026). Predictive Governance in Digital Enterprises: An LSTM-Enhanced Deep Learning Framework for Economic Optimization of IT Incident Management Using Enriched Process Logs. *Al-Farooq Journal of Sciences*, *2*(3), 86-113.
Efficacy of Curcumin on Inflammatory Biomarkers in Type 2 Diabetes: A Meta-Analysis of Clinical Trials and Animal Studies Systematic Review & Meta-Analysis (PRISMA 2020) Field: Botany & Complementary Medicine. (2026). *مجلة الفاروق للعلوم*, *2*(2), 15-35. https://doi.org/10.65405/9wp1fk50
Tariq Alnnale. (2026).Predictive Governance in Digital Enterprises: An LSTM-Enhanced Deep Learning Framework for Economic Optimization of IT Incident Management Using Enriched Process Logs.DOI: https://doi.org/10.65405/dctw1z34.
Mcfarlane, D., & Ogazon, A. (2011). The Challenges of Sustainability Education. *Journal of Multidisciplinary Research* (Miami Gardens, Fla.), 3(3), 81.
Mintz, K., Talesnick, M., Amadei, B. and Tal, T. (2013) Integrating Sustainable Development into a Service-Learning Engineering Course . *Journal of Professional Issues in Engineering Education and Practice* ·

O'Brien, C. (2010). Sustainability, happiness, and education. *Journal of Sustainability Education*, 1, 1–18
Peer, S., Goldman, D., & Yavetz, B. (2007). Environmental literacy in teacher training: Attitudes, knowledge, and environmental behavior of beginning students. *The Journal of Environmental Education*, 39(1), 45–59.
Rahim, J., & Gorges, A. (2018). Educating science teachers for sustainability: questions, contradictions and possibilities for rethinking learning and pedagogy. *Cultural Studies of Science Education*, 13(2), 581–598.
Stratton, S. (2015). Educating science teachers for sustainability (1st ed. 2015. ed., ASTE Series in Science Education). Cham, Switzerland: Springer.
Suwaed, H. (2022). Raising Libyan EFL undergraduate students' awareness about environmental issues through project-based learning. *Global Journal of Foreign Language Teaching*. 12(3), 112-123.
Suwaed, H. (2024). 'The Path Less Taken': Integrating Environmental sustainability and Protection in the Libyan EFL Teacher Education Programmes. *IJAEDU- International E-Journal of Advances in Education,* l (27 &28), 75-84.
Tasiopoulou, et al. (2020). STE(A)M IT Integrated STEM teaching State of Play, European Schoolnet, Brussels.
Timm, J., & Barth, M. (2020). Making education for sustainable development happen in elementary schools: the role of teachers. *Environmental Education Research*, 1–17.
UNESCO (2005). Contributing to a more sustainable future: Quality education, life skills and education for sustainable development. Retrieved from UNESDOC Digital Library:
UNESCO (2012). Exploring sustainable development: A multiple perspective approach. ESD in Action, Learning and Training Tools No. 3.
UNESCO (2016). Global education monitoring report summary 2016: education for people and planet: creating sustainable futures for all. Retrieved from UNESDOC Digital Library: https://unesdoc.unesco.org/ark:/48223/pf0000245745
Waas, T., Hugé, J., Ceulemans, K., Lambrechts, W., Vandenabeele, J., Lozano, R., Wright, T. (2012) Sustainable Higher Education – Understanding and Moving Forward. Flemish Government – Environment, Nature and Energy Department, Brussels.
Zachariou, F., Tsami, E., Chalkias, C. & Bersimis, S. (2017). Teachers' attitudes towards the environment and environmental education: An empirical study. Int. *Journal of Environmental Science Education*, 12, 1567–1593