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RESEARCH ARTICLE

An Organized Review of the Literature on How Jordanian Curricula Include STEM-Based Education for Sustainable Development (ESD) to Improve the Quality of Instruction

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ABSTRACT

Encouraging high-quality education by including STEM-based Education for Sustainable Development (ESD) has drawn a lot of attention. The quality of education can be improved by integrating STEM-based ESD since it offers interdisciplinary learning opportunities that include students in real-world, practical experiences. This research aims to examine the current empirical literature on the application of STEMESD and determine how well it fosters educational excellence. This study's objective is to examine and highlight a few current instances of how science and related curricula in Jordan are incorporating Education for Sustainable Development (ESD) in a way that makes sense to faculty and students. This study looks at competencies and pedagogical strategies, putting them together in a framework based on twelve competencies and twelve pedagogical techniques that have been documented in the literature. It also reflects on different embedding tactics and discourses. To do this, hermeneutics is employed. Encouraging future generations with a broad range of sustainability competencies will help shape their attitudes and behaviors. This essay will analyze the relevance of the concept of sustainable development, which is usually more impacted by global challenges, with a particular emphasis on Jordan as a global South country. The application of the concept of sustainable development in Jordanian higher education, a subject that greatly influences the personalities and conduct of young people in the future, will be the main emphasis of the research.

INTRODUCTION

As governments, institutions, and even individuals are now accountable for achieving the Sustainable Development Goals (SDGs), public knowledge of the goals is essential to support any further implementation-related initiatives. This is because the SDGs are a global idea. When university students understand the extent of the SDGs, they can support, promote, and achieve development. This study set out to assess the level of knowledge that university students had on the Sustainable Development Goals (SDGs) [1]

Typically, to end poverty, protect the environment, and ensure that everyone lives in peace and prosperity by 2030, the United Nations approved the Sustainable Development Goals (SDGs), also known as the Global Goals, in 2015.

The 17 Sustainable Development Goals (SDGs) recognize the interdependence of many areas and the need for development to balance the sustainability of the environment, society, and economy. States

have committed to prioritizing the development of the least developed countries. The SDGs seek to end poverty, hunger, AIDS, and discrimination against women and girls. The creativity, knowledge, technology, and financial resources of all members of society must be used to achieve the SDGs in every context.

MATERIALS AND METHODS

To gain a good understanding of a particular subject, a systematic literature review usually entails carrying out extensive and detailed searches in order to locate, assess, and summarize all pertinent papers. For this review, information was gathered from five sources using electronic search databases: Science Direct, Taylor & Francis, Springer, and Scopus. Using a combination of keywords, the databases were searched for "STEM AND EDUCATION FOR SUSTAINABLE DEVELOPMENT," producing 7,209 articles (n = 7,209). After removing duplicate items, the dataset was further condensed according to certain eligibility requirements. Three primary requirements for article eligibility were covered in the review.

Initially, we concentrated on compiling journal articles from the first and second quartiles (Q1-Q2) of the Scimago Journal Rankings that were indexed in Scopus. Articles with the terms "STEM" and "Education for sustainable development" in the title, abstract, or keywords were included in our search. The chosen publications covered educational interventions used in both formal and informal learning environments, with a focus on promoting STEM-based sustainable education development (ESD).

The paper ends with a presentation of its findings and a conclusion on the use of STEM-ESD. After these eligibility requirements were applied, only fifteen articles were chosen to serve as study samples. There were two phases of the analysis. Case analysis was the initial step, in which each article was looked at and summarized separately. A cross-case analysis was carried out in the second phase. As shown in Table 1, the extracted STEM-ESD application from each article was rearranged, and comparable components were aggregated to create four unique categories. The suggested teaching and learning strategies for STEM-ESD were then created by concentrating on the instructional strands that were used the most frequently in the papers that the systematic review examined.

Table (1): Analyzing cross-cases

Category	Specific Coding	Source
1. Impact STEM-ESD	Self-efficacy and involvement of students	-Zidny and Eilks [16] -Trott and Weinberg [17] - Zowada et al [18]
2. STEM-ESD based local wisdom	Knowledge of the students	- Sass et al. [19] - Vallera and Bodzin [20] - Agirreazkuenaga and Martinez [21] - Olsson et al. [22]
3. ESD	Ecological consciousness	- Zidny and Eilks [16]

A comprehensive and methodical evaluation of the literature was carried out, covering publications that were published between 2017 and 2023. Articles were chosen according to predetermined inclusion criteria, with an emphasis on foreign journals classified as Q1 and Q2 in Scopus and having an index. Numerous facets of STEM-ESD were investigated in the research, such as how it affected critical thinking abilities, system thinking, and self-efficacy. Table 1 displays the findings of a cross-case analysis of STEM-ESD to support high-quality education from multiple journals. There is a relationship between the STEM approach and sustainable education, or ESD. In addition, the integration of STEM education can enhance students' engagement and sense of self-efficacy, a noteworthy finding of using STEM is the high degree of student engagement and interaction during group work. Students are also demonstrating peer teaching, particularly when learning about

technology in groups, which helps to address the problem of skill disparities amongst students. The quality of education can be raised by implementing STEM-ESD curriculum. One way to implement STEM ESD instruction and enhance quality is by exposing students to environmental challenges. Students' engagement can be aided by presenting environmental challenges through STEM-ESD, which will enable them to think critically and methodically about solutions to those environmental problems.

Some of the points covered in this literature review are the following: how STEM-ESD influences students' self-efficacy and encouragement; how STEM-ESD affects their critical thinking and system thinking skills; how STEM-ESD based on local wisdom influences their knowledge; and how STEM-ESD influences their environmental literacy and environmental awareness. As a result, STEM-ESD education might become a crucial component of the curriculum in schools. Therefore, to promote the SDGs 2030 program, particularly in light of the quality of education, this research advises that STEM-ESD learning be applied at every level of education, from elementary school to university level.

Students' engagement with science is demonstrated by their discussion of issues that affect their immediate environment (2020) and by their pro-environmental actions, which include reducing waste, conserving water, protecting wildlife, and engaging in a range of sustainable practices.

The Jordanian government is stepping up its efforts to meet its TES duties and achieve SDG 4 before of the 2023 SDG Summit. The Jordanian government's efforts to enhance every child and youth's access to and retention in high-quality education from early childhood education through higher education, including technical and vocational education (TVET), are spearheaded by the Ministry of Education. To achieve this, the following top initiatives will be managed by the Ministry of Education:

(i) Expanding the number of opportunities for children under six to be enrolled in the educational system and stepping up efforts to make KG2 ubiquitous.

(ii) Fighting learning loss by working to raise achievement levels, close achievement disparities, and raise the caliber of student results while simultaneously halting the COVID-19 epidemic's detrimental consequences on education.

(iii) Accelerating opportunities for professional development for pre-service and in-service teachers.

(iv) Reorganizing public university TVET and vocational education programs to better suit the needs of the labor market.

Through this initiative, Jordan will build on its numerous pledges, plans of action, and strategies that are now fully aligned with SDG4, providing the structure necessary to facilitate the acceleration and transformation of SDG4 targets and goals. More specifically, Jordan wants to speed up the KG2 universalization process by updating existing legislation, enhancing relations with the business community, and increasing infrastructure spending. The Ministry of Education's National Plan for Remedial Education will be centered on school development and capacity building, curriculum updates to meet learners' needs, careful observation of student assessment and accountability for educational quality, and efforts to ensure social inclusion in the school environment. Jordanian institutions will also be introducing improved teacher training programs to meet the requirements of the Ministry of Education and improve teacher qualifications to improve pre-service teacher training. The Jordanian government also intends to mandate pre-and in-service training by 2025. This will also entail professional development for teachers with an emphasis on diversity and inclusion in education, with a special focus on children with disabilities, to ensure that no student is left behind in the classroom. The development of new vocational specializations will be given top priority by the Ministries of Education and Higher Education. They will also invest in the professional development of educators and youth in general, focus on enhancing and narrowing the scope of career counseling, and increase their engagement with the private sector.

The Ministry of Education is also working on digitizing vocational workshops to make them more accessible. To implement the aforementioned goals, the Ministries of Education and Higher Education will work closely with partners and stakeholders in the Jordanian education system. As implementation modalities, they will also employ financial support, public-private partnerships, and technical help. The in-kind contribution from the Ministry of Education will also utilize its present human and financial resources. Higher education for sustainable development has been the subject of more research and application in the last 20 years. These have mostly focused on imparting sustainability knowledge to the next generation of professionals.

The integration of SD into university courses has come a long way in this regard. Most of these projects have been focused on creating and offering competencies that are sustainable. Since all educational professionals receive their education in postsecondary education, they all must possess an understanding of ESD.

By prioritizing sustainability as an academic and organizational priority, leaders in higher education institutions may significantly contribute to the development of an egalitarian and environmentally responsible future. In addition to doing research, universities and higher education networks can provide counsel and recommendations on how to improve national education systems and enhance the potential for sustainable development in a range of industries.

ESD and Higher Education Are Related by the UNISCO Education Sector

Higher Education Institutions (HEI) can provide information and support for regional ESD projects. They can combine local knowledge and expertise with information kept at higher levels. HEI can use evidence-based data and problem-based scientific research to improve the relationship between research findings and decision-making. Universities and other higher education institutions are essential to the accomplishment of all ESD-GAP Priority Action Areas. Research on and implementation of Higher Education for Sustainable Development (HESD) has increased during the last two decades. These initiatives to teach sustainability have been directed toward future generations of professionals [2] and incorporate sustainable development (SD) into the operations, research, community outreach, evaluation and reporting, cooperation with other academic institutions, on-campus life experiences, education, and "Educate-the-Educators" programs of Higher Education Institutions (HEIs) [3]

Multidisciplinary methods, systems thinking, and innovative teaching strategies that provide immersive, transformative, interactive, and real-world learning are all necessary for incorporating SD into the curriculum. Most attempts to incorporate SD into curricula have focused on curriculum design and delivery [4] or learning outcomes [5]

It's a great time to reflect on our role in helping them achieve their goals. By choosing to teach students about the 17 Sustainable Development Goals, educators may actively support Goal 4 of the Quality Education SDG. "Education is both a goal in itself and a means for attaining all other SDGs," says UNESCO. Not only is it an essential part of sustainable development, but it is also one of its primary facilitators. It is essential to use education as a tool to accomplish the SDGs because of this. Education Minister H.E. Prof. Azmi Mahafzah unveiled the Crisis and Risk Management Strategy for the Ministry of Education in Jordan (2023–2027), indicating a major improvement in the sector's crisis response skills. The objective of the Crisis and Risk Management Strategy is to guarantee that the Ministry of Education (MoE) can go on offering top-notch instruction in a secure environment, despite the many hazards and threats Jordan encounters. The strategy is to reduce the risks to Jordanian education by outlining crucial system-wide strategic initiatives and to make it possible for education stakeholders, such as schools and students, to take a decentralized and localized approach to risk and crisis management.

With technical support from UNESCO and its International Institute for Educational Planning (IIEP), the Strategy was created through an extensive consultative process including the entire Kingdom. It is consistent with the Jordanian Natural Disaster Risk Reduction Strategy (2023–2030) of the National Center for Security and Crises Management (NCSCM). The Ministry's Education Strategic Plan (ESP) 2018–2025 also places a strong emphasis on crisis and risk management as a way to support system strengthening and ensure that everyone has access to inclusive, egalitarian, and high-quality education.

The Minister of Education was complimented for developing the Strategy by Ms. Min Jeong Kim, the UNESCO Representative to Jordan. Jordan has demonstrated its commitment to ensuring that every child and adolescent can once again enjoy their right to an education. By institutionalizing crisis-sensitive planning, the Ministry is establishing the foundation for the Kingdom's educational system to become more resilient, efficient, and adaptable. "Risk management is a regional and global concern that requires strengthening national policies, strategies, and plans in line with international frameworks like the Sendai Framework for Disaster Risk Reduction.

H.E. Mr. Saleh al-Sheyyab, Director of Strategic Planning at the National Center for Security and Crisis Management declared, "The Ministry of Education has accomplished this." H.E. Prof. Azmi Mahafzah thanked UNESCO and IIEP for their assistance in the development of the strategy and underlined the importance of cooperation at all levels as a crucial element of crisis and risk management.

"The Ministry of Education will be able to further ensure that it can fulfill its obligations to guarantee the provision of high-quality education in times of crisis with the assistance of our partners in this vital field and collaboration with the NCSCM." He said, "Our administration has set this as one of its objectives, as detailed in the ESP and Economic Modernization Vision. In addition to introducing the strategy, the MoE recently created a Risk Management Unit for the first time, with help from the IIEP and UNESCO. This unit will be essential to implementing the plan. The Unit is working with key MoE authorities to produce a costed operational strategy already.

UNESCO is supporting the MoE for crisis-sensitive planning as part of the System Strengthening Partnership (SSP), which is currently being carried out under a Multi-Partner Trust Fund (MPFT) supported by Canada, the Italian Agency for Development and Cooperation (AICS), Norway, and Switzerland. H.E. the Minister of Education oversaw the introduction of the Crisis and Risk Management Strategy. There were significant education industry partners and stakeholders in attendance, along with representatives from the National Center for Cybersecurity and the NCSM.

Theoretical Frameworks for Sustainability in Stem Education Stem

STEM Education: Theoretical Frameworks for Sustainability is an acronym for math, science, technology, and engineering. The phrase is relatively new, having originated in the US in the late 1990s with the National Science Foundation's mission to promote students' interest in and competence in STEM topics while bringing disciplines together.

Because of their bold aim of combining four complex fields, which bears the risk of continuing to engage with unrelated areas, there is a great deal of uncertainty around STEM approaches [6]

New frameworks, examinations, standards, and conversations regarding the state of education in the future and the need to prepare the next generation for the problems of the twenty-first century have been produced by international organizations. However, as noted in report 172 that followed the decade of education for sustainable development, reaching teachers and students—beyond the level of policymakers and connecting and transforming the educational experience—has proven to be a more significant challenge [7]. Sometimes these discourses, however, have trouble translating into the realities of the classroom. Ages 4 to 10 are the primary focus of secondary and higher education in the literature on STEM education opportunities. It consists of theoretical underpinnings, useful

recommendations, and anticipated learning objectives. Terms take into account the social and behavioral sciences as well as the scientific and computational sciences.

The goal of integration in STEM frameworks is to foster critical thinking, problem-solving, and retention by making connections across many courses, beginning with real-world scenarios. This harmony between integration and disciplinary knowledge is consistent with discussions of science and complexity in philosophy as well as the capacity of contemporary science to address challenging global issues in a variety of settings. To prevent biases in scientific activities, contextual knowledge is essential. There are three main methods to include learning about the Sustainable Development Goals into your curriculum: by extending current curriculum themes, by including national and international commemorations, or by adding SDG units or making connections to school events.

Given the many opportunities to enhance current topics by learning about the SDGs, the 17 SDGs need to be able to be mapped to either subjects or themes. To consider age appropriateness and accessibility, it is best to complete this as a staff-wide activity. For instance, given that students in this grade range may have visited hospitals, dentist offices, or doctors, teaching kindergarten through second-grade students about the SDGs related to experiences they are more likely to have had—such as Goal 3, Good Health and Well-Being—would be a good place to start.

Encourage students to reflect on the challenges faced by those who lack access to sufficient food, clean water, proper nutrition, and cleanliness to broaden their understanding of the world and themselves beyond what they learn in science or health classes. A simple experiment that replicates the spread of germs and the need for soap and water as defenses against them can be done with glitter or a UV-only spray.

Fostering empathy for individuals in circumstances different from our own can be greatly benefited by using simulations. Using cookies to show how food is spread around the world or jugs to show how readily available and high-quality drinking water is can be evocative and meaningful for younger pupils. Divide the class into equal groups; 4-6 children is a reasonable amount. Each party gets a certain amount to split; this might be anything from a single cookie crumb to the full bag. Praising these differences and pointing out how unfair the situation is exposes pupils to difficult topics like Goal 2's Zero Hunger.

Implications of Including ESD in Stem Courses

TEM subjects are one particular area where education for sustainable development (ESD) is being used. This initiative aims to increase students' awareness of the links between their field of study and sustainable development, as well as their potential impact and role in achieving it. Additionally, it cultivates skills that will benefit them in their future careers, where they will likely have the chance to positively impact people and the environment.

While there are many places where education for sustainable development (ESD) can be done, some are particularly interesting, such as the South countries where the current project was carried out. This region is characterized by rapid changes in geopolitical contexts and the increasing geopolitical significance of managing natural resources and the environment.

There are several challenges facing schooling in this unstable situation, which is characterized by the shift from one environmental emergency phase to another environmental integration phase. [21]. The idea of developing training programs to prepare students for careers in fields 5 related to sustainability has received a lot of attention. Over a lengthy period, from Rio 1992 to Rio + 20 (including the United Nations Decade of ESD) (UN 2012; UNESCO 1992, 2004, 2005), providing a suitable profile that takes sustainability issues into account has been emphasized in several UNESCO documents.

The establishment of specialized training programs is the goal of Agenda 21 (UNESCO 1992), which aims to guarantee that all societal sectors have the skills required to carry out their work in a sustainable manner. Point 51 of the UN report from the Rio + 20 Conference (UN 2012) emphasizes the importance of education and recommends that workplaces should be used as hubs for sustainability-related information, training, and education. According to Point 230, training programs that educate students for professions in sustainability-related fields should be developed, as well as curricula centered around the subject. ESD is a broad concept that includes understanding concerns about sustainable development and fostering participation in decision-making processes (UN 2012; UNESCO 1992, 2004, 2005). the acquisition of knowledge, 20 skills, concepts, and values to empower people of all ages to take on responsibility since it is imperative to get ready for a sustainable future.

In general, academics and government officials in Jordan (MoE and MoHESR) recognize the importance of STEM. The economy, business, and government frequently lack a thorough understanding of the factors that make STEM important.

It is necessary to facilitate understanding of the relationships between STEM competencies and basic economic necessities, higher education, technical education, vocational education, and general education. The strong links between STEM education, learning capacity, and long-term competitiveness are not well known among Jordanians. Consequently, it is imperative to engage in industry-specific collaboration, formulate a competitive strategy, identify the capabilities required for long-term success in that strategy, and disseminate these developments to the corporate, government, and academic communities. Businesses and acknowledged economic sectors won't proactively seek high-quality STEM education unless they have demonstrated and connected the importance of this kind of education to businesses.

In addition, retraining of secondary school teachers is required nationally to enable them to teach STEM courses in an integrated manner that encourages students' active, interdisciplinary learning. Changing the way STEM subjects are taught would enable children to tackle problems in a more innovative and skilled manner. STEM education stands for science, technology, engineering, and math education. STEM education is becoming an increasingly important tool for national development. As a result of its influence on how people perceive and understand the world in the future, STEM is increasingly acknowledged as a developmental norm. As a result, STEM education is emerging as a crucial educational paradigm for a market that is competitive worldwide.

Most Jordanian academics understand the importance of STEM. This knowledge is gleaned via reading about and following up on recent educational innovations carried out by scholars and government agencies, but it is not entirely clear why the conclusions drawn about the importance of STEM are valid. This ignorance is made abundantly clear by the fact that none of the most recent development programs, such as JV 2025 and the National Employment Strategy (2011–2020), particularly identify STEM education as a goal or a necessary element for long-term economic success. Therefore, it is unlikely that focused and direct initiatives to boost STEM development will be made anytime soon.

One of the main factors contributing to Jordan's situation is the fact that the majority of the country's enterprises are micro, small, and medium-sized. The majority of these companies don't perform any valuable tasks. As a result, the great majority of the economy either ignores or underestimates the potential financial gains that particular companies could make from improved STEM and vocational education and training. Due to low perceived worth and a real incapacity to exploit such abilities (caused by subpar value-adding processes), the private sector needs inexpensive labor input rather than skilled workers. If the commercial sector valued STEM competencies in addition to skilled technical and vocational labor, it might effectively advocate for effective STEM education at universities and VET programs.

Jordan has consistently invested in the education and training of its people. King Abdullah the First of Jordan had this mentality to overcome the challenges to the nation's growth posed by its scarcity of natural resources. Even now, people still think in these kinds of ways. Education reforms were introduced in the early 1990s. The reform of education has advanced and accelerated under King Abdullah II. The most recent economic objective of the educational reform initiative was to position Jordan as a leading player in the world economy and a center for technology in the region. The Vision and Mission for Jordan's national education were developed and accepted at the end of 2002. Three national advisory documents established the nation's vision for the required educational change and offered direction [8]

Recently, the National Centre for Human Resource Development (NCHRD) has conducted several sectoral studies and several national initiatives, such as the Jordanian National Employment Strategy and the Jordan Vision 2025 (JV 2025), which have all suggested, to varying degrees, industries with growth potential and some that require skills equivalent to those found in universities. Regarding student competency, STEM education, and the links between STEM and the economy, these studies don't go into great detail. This implies that there are very few if any, links between STEM and the needs of national human resource development.

Because of this, their links to the private sector and the national economy are shaky, even though there are numerous national institutions entrusted with employment, education, vocational/technical training, and national economic development. Since micro, small, and medium-sized businesses make up the bulk of Jordanian firms, it might be challenging for them to identify the specific and collective skill requirements that they need. Poor links result from this. As a result, there is a lack of practical understanding regarding the relationships between STEM and skill sets and competencies that are essential to the economy. The National Human Resource Development efforts are built upon the multiple studies that have been created and conducted over the past few years.

Among these studies are the UNDP/JICA study The Labor Market: The Case of Vocational Training in Jordan, the National Employment Strategy, and the National E-TVET Strategy of Jordan. None of these studies identify STEM as a topic of interest overall. Two studies (using the TIMSS and PISA tests) claim that STEM topics, such as science and math, are the only factors that need to be measured to be compared to other countries. Moreover, most studies emphasize generic labor shortages in the market without delving deeply into the skills and knowledge required to maintain, grow, and cultivate burgeoning economic sectors. Consequently, there isn't a functioning national policy in place for the development of human resources.

Including Sustainability in Stem Programs

It is essential that knowledge and information be shared with everyone, showing them that everyone can contribute to the realization of SD, since the general public's comprehension of Agenda 2030 and the SD idea is lacking in Jordan. It is much more important to implement these issues in Jordanian education, particularly at the tertiary level where institutions have a big impact on the behavior and personality development of young people. Therefore, our objective is to look into and assess how the SD idea is applied at Jordanian universities.

Jordan's educational system is undergoing a fast overhaul. The main goals are developing curricula, preparing instructors, leveraging communication and information technologies, improving methods of instruction, and adding new courses. Education for SD can enable concerned individuals to build a future that is economically, ecologically, and socially sustainable by teaching them how to think critically and solve problems.

The main challenge in Jordan is how to merge all sustainability ideas and principles within various educational activities in different universities as there are about two hundred thousand university students who have a direct effect in any social change. The integration of this education is important

also to find new ways to create knowledge needed in a world characterized by a turbulent environment and increasing changes [9]. Several studies show that the Education for SD was not adequately clear in prior years, according to the majority of research workers at Jordanian universities as well as students. Most academics did not consider different sustainability challenges when they were teaching unless these issues came by mistake. The primary problem was a lack of instruction to build sustainable teaching skills. New staff training initiatives were introduced in addition to other adjustments to raise awareness among academics and students.

Numerous STEM courses have incorporated environmental and social themes through either new or modified versions of the existing curriculum. Given that these activities typically include the consumption of resources and energy as well as modifications to the surrounding environment, this has likely been noticed in the engineering profession. This final principle is especially pertinent to the field of civil engineering. A few instances of change include the use of life cycle or sustainability assessment techniques, sustainable materials and design, systems analysis, and evaluations of clean technologies such as renewable energy [10]

Sustainable development is crucial to the economy and society of the twenty-first century, but there is often a disconnect between students' everyday experiences in the lab and the ideals for its realization that they are exposed to from their institutions, the media, and other sources. Overall, this area continues to have a very significant environmental footprint with little genuine work taken to minimize it (energy use up to five to ten times that of an office building per square meter, for example), especially when compared to other campus areas. According to Labs 21, users can mitigate some of this environmental impact by being more aware of how their lab activities affect the environment. Additionally, there are ways to incorporate these insights into the STEM curriculum by having students gain the ability to reflect on and devise plans to affect activities in their own labs. Additionally, a lot of STEM courses require fieldwork outside of the host institution.

Long-term STEM education has the following benefits:

(1) Promoting Critical Thinking: As part of STEM education, students are urged to exercise critical thinking, investigate problems, and provide innovative solutions. We assist them in becoming more skilled at approaching environmental issues analytically by adopting sustainability principles.

(2) Promoting Multidisciplinary Collaboration: In order to solve sustainability issues, multidisciplinary approaches are required. STEM education brings together students from diverse backgrounds and fosters collaboration in fields such as environmental science, engineering, and biology. This collaboration promotes crucial teamwork skills and comprehensive problem-solving.

(3) Building Resilience: Students who are taught in a sustainable STEM setting are better equipped to handle uncertainty and adapt to changing environmental conditions. Students are taught to overcome challenges, attempt new things, and learn from their failures when a creative culture is fostered.

(4) Encouraging Moral Judgment STEM education teaches students to think about how decisions they make will affect society and the environment by examining the moral dimensions of sustainability.

This promotes moral decision-making and compassion for all living things, including the environment.

The ability to conduct fieldwork is, in fact, one of the key abilities in many applied and research-led STEM courses. Design and technology work well together to promote creativity, problem-solving, and collaboration. Students that participate in practical Design and Technology projects gain communication, problem-solving, critical thinking, and teamwork skills—all of which are highly valued in the job.

Science education may tackle difficult problems like socio-ecological problems and climate change by encouraging interdisciplinary discussion and addressing the meaning loss that occurs when attempting to solve a problem that defies logic or moral presumptions. Enrique Leff [11], a Mexican sociologist and expert in environmental education, highlights the importance of environmental pedagogy. His revolutionary perspective offers educational pathways to challenge modern rationality, which is based on the principles of reductionism and objectivity found in contemporary science. Critical pedagogies inspired by Freirean conceptions (Freire [26-27], 1978, 1998) form the basis of this perspective. The reductionist scope, in his opinion, has made science more effective and specialized.

Environmentalists generally hold a negative opinion of the chemical business, and the public often perceives its products, or "chemicals!" as inherently hazardous and dubious. This is reflected in several policies and initiatives, including the newly passed European REACH (registration, assessment, authorization and restriction of chemicals) directive and supply chain initiatives by several retailers. This scant regard for the environment is reinforced by the fact that 90% of organic chemistry production is still attributed to oil, which leaves an enormous carbon imprint.

Throughout the past 10 years, there has been a rise in the body of literature discussing and disputing the definition and use of competencies for SD. Several writers have put up lists of competencies about education for sustainable development and how to use them in recent years. The Barth group [10] talked about how higher education shaped SD's key competencies, with a focus on how these characteristics impacted both formal and informal learning environments. The acquisition of genuine important SD competencies through learning opportunities was discussed by Brundiers et al. [11]. et al. A comparison between the SD competencies engineers have gained and the industry needs was provided by Hanning [12].

DISCUSSION AND SUMMERY

The results indicate a noteworthy and growing interest in incorporating SD concerns into Jordanian higher education. However, there are still some contexts in which the level of attention and presence of the SD idea and method can be increased. As a result, we conclude with the following recommendations, which are based on the results of our research and analysis. The application of STEM-ESD learning can raise educational standards, as can be inferred from the study and discussion that followed. One way to implement STEM ESD instruction and enhance quality is by exposing students to environmental challenges.

The 2030 Agenda still requires greater public and civil society awareness, which includes understanding the nature and potential of the SDGs as well as how individuals and institutions need to adapt to address SD in all areas of education systems, not just specific study centers or programs. To guarantee that every student receives the appropriate education, comprehension, and training, the Sustainable Development Goals (SDGs) can be integrated into all academic programs. Support from the federal government is also required. Greater support from the commercial sector would also be appropriate and advantageous. [13] Affected by globalization and related concerns, "In the context of the demands of modern society, there is a need to develop new global skills for today's global labor market."

Through ICT, online social networks, and community media, it is vital to promote greater transparency and expanded access to data and information for the government, institutional authorities, and entire civil society in order to raise awareness of the concerns [14]. Jordan's higher education system can benefit from more practical learning in the field of SD education. While gaining theoretical knowledge and information is important, its full impact cannot be realized until it is appropriately applied to practical situations. It is important to educate students about reality and

how they may each personally contribute to global sustainability. Young people in particular need to have a deeper understanding of their role in this process [15].

Sustainable STEM education is a revolutionary force that can help design a wealthier and more ecologically friendly future for our globe. By teaching our kids to be environmentally conscious in this digital age, we educate them to be the environmental stewards that our planet sorely needs. Together, let's take advantage of the chance that STEM education offers and make a clear step toward a prosperous and sustainable future.

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