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Sustainability in Education and Healthcare field: An Integrative Review of Factors, Barriers, and the Path Forward for Informed Practices

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Authors

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REVIEWS

Sustainability in Education and Healthcare Field: An Integrative Review of Factors, Barriers, and the Path Forward for Informed Practices

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Abstract

Purpose: **This integrative review consolidated and synthesized diverse research articles aimed at investigating various environmental factors in sustainability education, including in the healthcare field. Likewise, it provided a holistic understanding of challenges, facilitators, and their significance.**

Method: **Eight databases with different search terms were searched in this integrative review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A total of 19 papers were quality evaluated using a standardized review tool.**

Results: **Three major themes emerged from the integrative review such as: "Factors affecting Sustainability Education" which include specific factors such as responsible environmental behavior, self-directed learning, and the importance of instructor involvement. Then, the second theme "Barriers and Facilitators to Environmental Health Integration," which explains that interdisciplinary collaboration and leadership are two of the factors that help with this process and lack of understanding of environmental health, competing curriculum demand, a lack of faculty competence in environmental health, limited resources, and resistance to change as barriers. Lastly "Importance of Sustainability in Healthcare Education" theme emphasizes the sustainability principles integration into the curriculum to enhance environmental health knowledge and practices.**

Conclusion: **The review highlights the importance of environmental sustainability education, especially in higher education and healthcare sectors. The insights provided baseline informations for implementing sustainable educational practices that encourage active engagement with environmental health issues. This review provides as a framework, guiding health educators, policymakers, and researchers towards promoting a more sustainable future through educational programs.**

Keywords: Barriers, Education pathway, Informed practices, Integrative review, Sustainability education

1. Introduction

Sustainability education is the educational sector's effort to address the United Nations Sustainable Development Objectives (UN SDGs). Education for Sustainable Development (ESD), also known as Education for Sustainable Development, aims to redirect education towards sustainable

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development [1,2]. Given the crucial role of education in sustainability efforts, it is necessary to incorporate sustainable development topics into teaching and learning methods, to inspire pedagogical approaches. The education sector boldly responded to the ambitious aim of releasing the United Nations Decade of Education for Sustainable Development (2005–2014) (DESD) Final Report. This report reinforces the role of the educational sector and its impact on sustainability. By integrating sustainability into educational methods, learners can adopt more proactive actions to alter their behavior and devise solutions to potential risks to humanity. Therefore, the inclusion of sustainability education has become essential, particularly in environmental education, higher education curricula, and healthcare. With the year 2030 approaching rapidly, there is a significant expectation for all United Nations member states to collaborate and take action to ensure peace and prosperity worldwide. This involves achieving the global goals set by the United Nations in 2015, as outlined by the UN Sustainable Development Group (UN SDG) in 2023. The release of Education for Sustainable Development: Towards Achieving the SDGs (ESD for 2030) by UNESCO in 2020 aims to enhance the efforts of the academic sector to promote sustainable development. Considering the crucial role of education and the remaining time of nearly seven years, it is vital to assess the progress made and the tasks that still need to be accomplished to attain this objective.

Sustainability education is continuously evolving as an essential part of achieving sustainable development goals. The release of ESD for 2030 further emphasises the importance of the academic sector on the achievement of goals as well as "review the purposes and values that underpin education and reorient all levels of education and learning to contribute to sustainable development and to strengthen education and learning in all activities that promote sustainable development." (p.12) [3]. Hence, the academic sector should be strengthened to take further action in incorporating sustainability through values, skills, knowledge, and abilities in the learning process [4]. Establishing a link between environmental, economic, and social systems and maintaining a certain level to avoid depletion of natural resources, sustainability is a state that aims for environmental equilibrium [5]. Incorporating the ideals of sustainability into education can be considered a quintessential strategy because it aims to equip and educate learners to achieve and maintain such a balance. Highlighting the role of the academic sector in the global movement to achieve sustainability through the release of ESD for 2030 has strengthened the potential for higher education to change lives. Higher education institutions not only grant scholastic degrees but also prepare lifelong learners. Given the multifaceted nature of sustainability education, there is a need for various disciplines to integrate sustainability into their learning processes.

Sustainability education traced back its humble beginnings in 1992 upon the release of Chapter 36 of Agenda 21, which was the first global action plan on sustainable development at the United Nations Conference on Environment and Development (UNCED). During the summit, UNESCO was tasked with developing a conceptual framework relevant to sustainability in education [6]. The following years became even more fruitful, with more initiatives related to incorporating and strengthening sustainability in education through various conferences, guidelines, declarations, and frameworks in many countries around the world. The adoption of the 17 UN Sustainable Development Goals (SDGs) as part of the 2030 Agenda for Sustainable Development reinforced the position of the academic sector as a key enabler in the achievement of worldwide sustainable development. This further led to the launch of the ESD for 2030 Roadmap which emphasizes the role of education in implementing all the 17 UN SDGs [6].

Despite the growing interest alongside the increasing pressure to achieve such a goal in a limited time, there is indeed a sizable knowledge gap towards sustainability education as well as the healthcare sector. The majority of the existing literature focuses on studies related to curriculum content, faculty engagement, or students' perceptions of integrating sustainability into the curriculum. Notably, comprehensive examinations seamlessly integrate healthcare and environmental sustainability considerations. Hence, this integrative review consolidates and synthesizes diverse research articles aimed at investigating various facets of environment sustainability education, including the healthcare field. Specifically, the objective was to provide a holistic understanding of the challenges, facilitators, and significance of sustainability.

This comprehensive assessment is of utmost importance in further discussions on sustainability education, particularly in the healthcare industry. First, it fills a noticeable gap in information by combining several research efforts that connect the fields of healthcare, education, and environmental sustainability. The synthesis enhances our understanding of the difficulties and facilitators and expands the discussion beyond the limited emphasis

on curriculum content and student perspectives. Furthermore, the review plays a crucial role in directing educators, policymakers, and researchers towards better-informed practices. The synthesis of diverse research provides a clear viewpoint on successful approaches to incorporating sustainability into healthcare education.

2. Method

2.1. Design

This review was employed using an integrative review [7]. In adherence to established standards, this review adhered to the guidelines outlined in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement [8].

2.2. Quality appraisal

The QualSysts, a standardized assessment method, was utilized to evaluate the rigor, quality, trustworthiness, and robustness of the chosen research articles [9]. This checklist covered crucial aspects of each study, including research objectives, design, methods, sample size, outcomes, analysis, and conclusions. The tool consists of 10 items, with a maximum score of 10 points, where scores of 2 and 1 are assigned based on the assessment. In instances where disparities arose in the evaluation of the article's quality, authors holding different perspectives actively participated in dialogues to achieve consensus regarding the articles. The evaluation of article quality using this instrument revealed a high level of consensus among the researchers, as evidenced by Cohen's kappa coefficient of 0.81, indicating good reliability. In summary, the included articles received scores ranging from moderate to high. The information collected from the identified studies encompassed details such as the author's name, publication year, tools, sample characteristics, the tool's validity and reliability, and key findings (See Appendix A).

2.3. Search strategy

Search Method: The databases explored were Google Scholar, PubMed, ScienceDirect, DOAJ, MEDLINE, CINAHL, Health Source, and Web of Science. The search strategy was based on iterative combination of keywords. The search was not limited in terms of years. The keywords were combined with Boolean operators such as 'OR' and 'AND'. Medical subject headings (MeSH) terms were also used in the search process. To complete the search, the same terms were used as keywords to search by title and abstract (Table 1).

2.3.1. Search criteria

Articles were selected according to the following inclusion criteria: no year publication restriction, peer-reviewed articles, English language, and full-text accessibility. Specifically, factors influencing sustainability education were also added such as sustainability concepts curriculum design, Teaching Methodologies (e.g., experiential learning, project-based learning, and interdisciplinary teaching), and Institutional Policies. Meanwhile, the exclusion criteria were sources that do not possess a clear and direct focus on sustainability within higher education, environmental health context grey literature such as books, reports, and policy documents (Due to lack of peer review, which can impact the reliability and validity of the findings).

2.3.2. Analysis

When the search criteria were applied, 18,400 articles were found across specified databases. Once duplicates were removed, there were a total of 12,032 articles remaining. In the screening of 6368, we excluded articles whose titles did not specifically address factors influencing sustainability education, the instruments used, or barriers to integrating environmental health concepts into higher education curricula. This process left us with 3908 articles. These remaining articles specifically focus on factors such as sustainability concepts, curriculum design,

Table 1. Search strategies.

Databases	Strategies
Web of Science Health Source: Nursing/Academic Edition CINAHL MEDLINE Complete DOAJ Science Direct PubMed Google Scholar	(Scale OR Tools OR assessment tools OR rubrics OR questionnaires OR survey [tw]) AND (environmental sustainability OR sustainable healthcare [mesh] OR environmental health [mesh]) AND (competence OR capability OR capacity OR learning OR skills OR training OR mastery [tw]) AND (understanding OR awareness OR insight OR intelligence OR Performance OR Practices AND attitudes OR Beliefs OR Opinions OR Perspectives [tw])

teaching methodologies (e.g., experiential learning, project-based learning, and interdisciplinary teaching), and institutional policies. Articles not covering these topics were removed. We reviewed the abstracts of 2460 articles based on our criteria. We included articles that were peer-reviewed, in English, and had full-text access. They needed to focus on sustainability education, including topics like curriculum design, teaching methods, and institutional policies. We excluded articles that did not clearly address sustainability in higher education. Additionally, we excluded grey literature, such as books, reports, and policy documents, due to the lack of peer review, which can impact the reliability and validity of the findings. Other exclusions were based on non-peer-reviewed sources or studies that did not meet the inclusion criteria. As a result, 2371 articles were removed.

Additionally, 70 articles were removed because they did not use standardized surveys or questionnaires for data collection. Standardized tools are crucial because they ensure consistency and comparability of data, which is essential for accurate analysis and reliable results. Without standardized measures, the data collected may lack uniformity, making it difficult to draw valid conclusions or compare findings across studies. As a result, 2371 articles were excluded, and 89 more were removed for not meeting the eligibility criteria.

Thus, the final selection comprised 19 articles and were evaluated using QualSysts [9] and identified to be relevant to the review (see Fig. 1). The selected

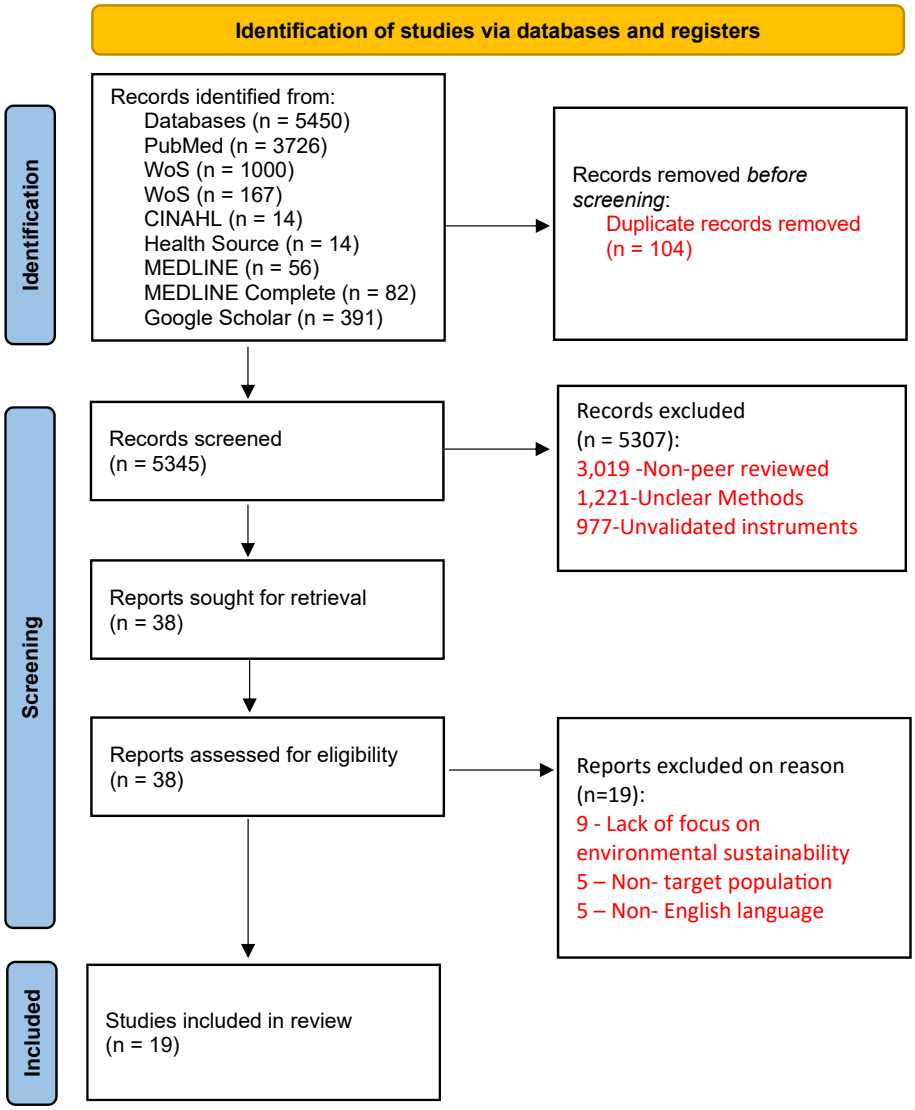

Fig. 1. PRISMA Flow diagram of the literature search.

articles were read, and the data were coded until the final themes were identified.

3. Results

The review included 19 articles: 14 quantitative studies and five mixed methods studies. Study samples included: six university students [10–15]; two teachers [4,16]; one university employees [17]; one registered nurses [18]; three nursing students [19–21]; one nursing interns [5]; one residents of communities with contaminated well water with university students [13]; one MOOC learners [22]; one high school students [23]; one household participants [24]; and two medical students [25,26]. It should be noted that some studies did not specify sampling strategies and country of research; however, some studies included multiple participants. Likewise, the results of the reviewed articles generated three major themes: Factors Affecting Sustainability Education; the Barriers and Facilitators to Environmental Health Integration; and the Importance of Sustainability in Healthcare Education.

3.1. Theme 1: factors affecting sustainability education

Six studies highlighted the factors affecting sustainability education [10,14,18,20,23]. One study conducted among 771 Japanese high school and university students revealed six factors that were found to be essential in sustainability education using a survey [23]. The first factor referred to a responsible approach towards the environment, whereas the second factor implied self-directed learning based on students' interests. The third factor considered the focus on relevant skills and knowledge to solve environmental issues, whereas the fourth factor included the importance of instructors in presenting environmental learning. Finally, the fifth and sixth factors were related to being conscious about physical experiences, such as avoiding dirty things, as well as the consideration of not imposing environmental learning on students. Similarly, Clery et al. reported that interactivity and participation were found to be crucial factors among 342 medical students towards achieving better learning outcomes in sustainability education, including peer learning and collaborative learning in an online learning environment based on Sustainability in Quality Improvement questionnaire [25].

Moreover, using the New Ecological Paradigm Scale, Ling et al.found that sociopsychology, including cultural contexts, was important in building 9031 higher education students' ecological worldviews [14]. For instance, as emphasized by Cruz et al., factors such as country of residence, type of community, and knowledge about environmental issues and their influence on health in nursing courses had an impact on the attitudes and views of 1059 nursing students towards climate change and environmental sustainability in the nursing curricula of Arab countries based on the SANS-2 questionnaire [20]. In addition, factors such as pollution, chemicals, and environmental diseases were found among 173 registered nurses, which were important in including environmental health content in nursing education, healthcare professionals, and the general public based on a survey [18]. The Sustainability Consciousness Questionnaire found that sources such as social media, news, and family and friends played a significant role in providing knowledge, attitudes, and practices related to sustainability education to 472 students [10].

3.2. Theme 2: barriers and facilitators to environmental health integration

Most studies have explored the barriers and facilitators of environmental health integration [4,11,15–18,22,24]. Two studies revealed barriers to healthcare practice, which included a lack of understanding of environmental health, competing curriculum demand, a lack of faculty competence in environmental health, limited resources, and resistance to change [17,18]. Meanwhile, the facilitators of environmental health integration were collaboration across disciplines, the practical application of environmental health curriculum flexibility, external collaborations, and supportive leadership. Barragán-Sánchez et al., based on a questionnaire on the eco-responsible use of technologies among 530 female and 248 male teachers, emphasized the development of a reliable instrument to train instructors in terms of ecological education within the implementation of technological advancements [16]. Similarly, Amador-Alarcón et al., based on an environmental protection questionnaire of 135 students, found that they were convinced to solve environmental problems with the optimal use of digital gadgets and responsible use of technologies regarding recycling processes [11]. For example, Tabuenca et al. used pre- and post-questionnaires among 3632 students from 64 countries and found that massive open online courses (MOOCs) and social networks were identified as facilitators and sustainable approaches to develop environmental awareness about worldwide ecological issues such as marine litter [22]. Similarly, Van Dongen emphasized that distance learning might be a useful way to promote accessible

environmental health programs and resources for students [18]. In addition, a survey conducted among 110 households in Beirut emphasized that while socioeconomic, locality, behavioral, and health variables explain some priorities, environmental belief variables are present as significant predictors of all priority variables [24].

Furthermore, a self-administered questionnaire administered to 361 students revealed that the sense of responsibility towards environmental sustainability increased with the help of green initiatives fostered by Pakistani universities at the institutional level [15]. Likewise, Khan and Terason noted that motivation and a responsible approach to the environmental system among faculty and university staff might increase with environmental seminars, workshops, and training across higher educational institutions [17]. An environmental awareness questionnaire among 160 future teachers found that students broadly had a positive attitude towards the implementation of sustainable development in their prospective teaching career [4].

3.3. Theme 3: importance of sustainability in healthcare education

Six studies emphasized the importance of sustainability in healthcare education [5,12,13,19,21,26]. Sustainability is becoming increasingly important in healthcare education, particularly in nursing and medical curricula. Traditional educational contexts are not the only determinants of sustainability education effectiveness. The significance of integrating sustainability issues across the curriculum, as opposed to isolating them within certain classes. Ibáñez et al., based on a questionnaire on environmental knowledge and environmental behavior among 1471 students found that they believed that environmental education was important in terms of achieving Sustainable Development Goals (SDGs), protecting natural resources, raising people's awareness of environmental education, and integrating sustainability education in the curriculum [12]. Similarly, Chen and Price used the SANS-2 questionnaire among 69 nursing students from China, and 32 students from England reported that students from both countries identified sustainability as an important issue for nursing and nursing curriculum, which implied waste management, integrating better teaching and learning approaches, learning certification, and evaluation of environmental aspects of healthcare education [19].

Moreover, Moustafa Saleh and Elsabahy, using the sustainability consciousness questionnaire among 160 nursing interns, emphasized that training programs on sustainable development should be in line with the needs of nursing interns based on updated teaching and learning methods, such as problem-based learning (PBL) [5]. For example, according to Gray et al., students' decision-making might be developed by integrating new information on whether drinking water is safe to expand their skills and knowledge based on environmental health literacy surveys [13]. Interestingly, the significant predictors of environmental and sustainability attitudes (SANS-2) among 280 Saudi nursing students were attending environment-related seminars and training, learning about environment-related topics in the nursing program, and awareness of climate change [21]. In addition, 851 medical students in the UK emphasized the importance of integrating sustainable healthcare in medical education with the help of experts in this field to feel more confident about it in future careers based on a survey [26]. The emphasis on sustainability within higher education institutions as well as the involvement of faculty members in implementing sustainable practices is equally significant.

4. Discussion

Several findings have been reported in this review. First, the factors influencing sustainability education, environmental health, and healthcare are broad and diverse, including individual, social, and cultural influences. According to several studies, demographic background, such as country residence and gender, affects people's attitudes, behaviors, and prioritization of environmental issues [12,14,21,23,24]. Moreover, several studies have found that social, cultural, and psychological factors also affect people's attitudes towards sustainability and environmental problems. For instance, Ling et al. concluded that demographics in terms of gender, political orientation, and major are important in shaping the ecological worldviews of students [14]. Likewise, Cruz et al. found that factors such as age, gender, community type and educational level influence students' attitudes and views towards environmental sustainability [21]. Both of these studies utilized the scale called New Ecological Paradigm (NEP) which is used to identify attitudes and beliefs towards environmental sustainability [14,21]. Moreover, these studies show good validity and reliability scores that accentuate the impact of demographic background on shaping the environmental views [14,21]. Thus, it can be suggested that in order to address different needs of people with diverse backgrounds, there needs to be a customized approach in promoting sustainability ideas.

Factors like peer learning, interactivity and participation are found to have a positive impact on knowledge and environmental attitudes [25]. This, in turn, can be correlated with findings that suggest the positive influence of social networks and media in raising awareness and knowledge, which also leads towards more positive environmental behavior [10]. However, in a study by Clery et al., there was a possibility of obtaining biased results because of the percentage of students who participated in a survey after attending the Sustainability in Quality Improvement (SusQI) program [25]. Meanwhile, tools used in a study conducted in Qatar lack reliability and validity checks, which in turn questions the accuracy and consistency of the results [10]. Regardless of the limitations, these findings suggest that sustainability attitudes, practices, and knowledge are more highly influenced by external factors than in traditional educational settings. This may help experts to efficiently use tools such as social networks, media, peer learning, and interactive learning to promote knowledge, positive attitudes, and sustainable practices among students.

Secondly, as mentioned above, social networks, distance learning, and media have also been identified as facilitators in developing positive environmental attitudes [18,22]. Thus, it can be suggested that the use of digital tools and platforms may help in addressing some of the environmental issues in a broader and more effective way. For instance, Amador-Alarcón et al. also found that digital tools can serve as facilitators of changes in students' attitudes, knowledge and behavior towards the environment [11]. On the other hand, several studies mentioned that a lack of understanding of environmental health, competing curriculum demands, insufficient competence of faculties, limited resources and resistance to change are found to have negative impact on addressing environmental challenges and promoting sustainability [17,18].

The third theme identified in this study was the significance of sustainability in healthcare, particularly in the nursing and medical curricula. These findings underscore the growing recognition that sustainability is a fundamental component of healthcare education, transcending traditional educational paradigms. Students acknowledge the importance of sustainability in addressing Sustainable Development Goals (SDGs), protecting natural resources, raising environmental awareness, and incorporating environmental sustainability into the curricula [5,12,13,19–21,26]. Studies done by Moustafa Saleh and Elsabahy [5], Cruz et al. [20], Cruz et al. [21] and Chen and Price [19] all utilised SANS-2 (Sustainability Attitudes in Nursing Survey) questionnaire which assesses student's attitudes towards the environmental sustainability in nursing and has good reliability and validity. Furthermore, studies focusing on students' perspectives regarding the implementation of sustainability education in medical curricula suggest students' willingness and positive attitudes towards sustainability education [19,26]. These findings reinforce the significance of integrating sustainability across the curriculum and preparing for future healthcare professionals.

The researchers believe that the results of this review will provide a better understanding of the existing practices as reflected on the articles that have been reviewed. For instance, the diversity of the factors influencing sustainability education and the healthcare system should be considered in formulating new strategies, approaches, and procedures. Such diversity of factors would entail a more customized approach in promoting sustainability ideals, moving away from the traditional approaches, thus, allowing new ways to promote sustainability in education. In addition, the positive impact and influence of collaborative or peer learning as well as the use of social media tools not to mention exploring the use of AI can also be utilized by medical/healthcare educators to promote sustainability in healthcare education. This also includes engaging in insightful conversations and addressing pressing concerns in a safe space or platform.

Moreover, integrating the ideals of sustainability in the curriculum is also one of the possible ways to promote sustainability. Integrating sustainability in the curriculum will help in preparing future healthcare professionals in instilling the value and ideals of sustainability not just in their professional practice but also as a way of life [27].

Further, since this review identified that one of the barriers in promoting environmental sustainability in healthcare is the lack of faculty competence, institutions and medical organizations may conduct professional development courses, workshops, seminars and other informative sessions. The results may also benefit leadership organizations that advocate for the integration of environmental sustainability into healthcare. Such institutions are important in helping healthcare organizations and educational settings in changing attitudes and behavior, and in achieving structural changes by organizing committees and/or green teams who will be responsible for planning, implementing, monitoring and evaluating the whole process [28].

Lastly, it is important to place the results and their consequences in the broader context by collaborating with stakeholders, encouraging students to solve real-world problems, and disseminating the

importance of environmental sustainability in healthcare to local communities. Possible directions for future research may also be identified.

Despite the broad possible implications of the findings of this review, there are several limitations that need to be considered in the future. First, the search was limited to specific databases, which may have excluded relevant publications from other sources. Furthermore, the review focuses on English-language articles, potentially omitting valuable research in other languages. Moreover, the quality of the included studies may vary in terms of validity and reliability, potentially affecting the accuracy of the conclusions.

5. Conclusions

The integrative review consolidates and synthesizes diverse research articles, aimed at investigating various facets of environmental sustainability education, including the healthcare field, encompassing three pivotal themes. Firstly, the Sustainability Education underscores complex challenges hindering the sustainability integration into educational frameworks. Secondly, the "Barriers and Facilitators to Environmental Health Integration" revealed strategies for integrating environmental health into educational contexts. Thirdly, "Significance of Sustainability in Healthcare Education" emphasizes the vital role of incorporating sustainability in healthcare education.

Furthermore, our review identifies several significant gaps in the literature on sustainability education. First, there is a notable lack of longitudinal studies examining the long-term impacts of sustainability education, particularly in tracking how it influences students' knowledge, behaviors, and career paths over time. Additionally, the research is often concentrated in specific regions and types of institutions, highlighting a need for studies that encompass a broader geographic and institutional diversity, including community colleges and non-Western contexts. Finally, there is limited focus on emerging sustainability issues, within educational frameworks, which warrants further exploration.

To broaden the relevance of our findings beyond healthcare and higher education, future research should explore how environmental sustainability education extends across diverse educational levels and learning modes. Investigating the adaptability of sustainability initiatives in preschool, school, vocational education, and online learning environments will reveal how environmental values and practices resonate across various educational levels and modes of learning. Furthermore, by considering both physical and online geographical contexts, researchers can evaluate how cultural nuances and environmental challenges influence the global implementation and effectiveness of environmental sustainability education. This comprehensive perspective will offer targeted insights for tailoring educational strategies to meet the distinct needs of diverse educational levels and learning modes, ultimately enriching the global impact and relevance of environmental sustainability education.

To advance sustainability education, we recommend several research directions. First, conducting longitudinal studies will provide insights into the long-term impacts of sustainability education on students' environmental attitudes, behaviors, and career trajectories. Second, research should explore diverse educational contexts and geographic locations to understand how different settings influence the effectiveness of sustainability education. Third, investigating emerging sustainability topics, such as climate resilience and social equity, will help assess their integration into curricula and impact on student engagement. Finally, Policymakers are urged to prioritize sustainability in educational policy formulation, create clear directives, and offer incentives to ensure effective incorporation of sustainability principles. This highlights the need for these efforts to enhance sustainability education and ensure educational frameworks effectively address current global challenges.

Ethics approval

As this review synthesizes existing literature and does not involve primary data collection or direct interaction with human or animal subjects, formal ethical approval was not required.

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Conflict of interest

None.

Appendix A.

Information of the studies included in the review

Author/year/ country	Design	Aim of the study	Sample population	Name of the Tool Validity and reliability of the tool	Key findings	Score %
Al-Nuaimi, S. R., & Al-Ghamdi, S. G. 2022 Qatar	Quantitative, case study Sustainability consciousness questionnaire (SCQ) Descriptive statistical analysis	To measure individual's awareness of sustainability. It focuses on individuals' knowledge, attitude, and behavior towards sustainable development.	Random sampling 212 Undergraduate, Master's and Ph.D. students in Qatar universities	Survey Monkey online questionnaire None	Findings revealed that 80% understand sustainability-related knowledge Students emphasized external factors, however, majority indicated that their attitude, behaviors, and knowledge toward sustainability is highly influenced by the learning resources and curriculum	78
Martínez-Borreguero et al., 2020 Non-specified context	Mixed methods study Descriptive and inferential analysis	To measure the participants' emotional, teaching self-efficacy, and environmental awareness to achieve sustainable development within the framework of waste	Non-probability sampling 160 teachers in training	Questionnaire (Unnamed tool) $\alpha - 0.62$ Homogeneity index and item−total correlation tests − 73.3%	Findings indicate that future teachers have a positive attitude towards including sustainable development in future teaching work Researchers suggest that education for sustainability should be integrated into the curriculum together with active learning approaches.	82
Chen, M. J., & Price, A. M. 2020 China and England	Mixed methods study	To explore sustainability education in nursing students in two countries	Convenience sampling 80 undergraduate student nurses in China and 40 in England	SANS_2 questionnaire $\alpha - 0.77$	Findings indicated that students have positive attitudes towards sustainability in both countries. Four themes emphasized that Chinese participants have greater awareness than English participants. It was also noted that all participants struggled to understand how sustainable practices can be implemented within healthcare together with high standards of patient care Active teaching and learning approaches were also mentioned by participants in terms of sustainability practices	86

Khan, M. S., & Terason, S. 2022 Thailand	Quantitative study	It aimed to find the relation between pro-environmental behavior (PEB) and environmental sustainability (ES) amongst university employees by introducing the moderating effect of green organizational culture (GOC)	Nonprobability sampling 185 university employees	Survey PEB scale with 27 items developed by Blok et al., 2015 GOC scale with six points developed by Afum et al., 2020 $\alpha - 0.7$ (values were greater than 0.7)	Findings revealed that PEB influenced ES whereas GOC had a moderating impact on PEB and ES. It was underscored that practical seminars, workshops, and trainings should be provided for faculty to enhance their understanding of environmental sustainability	82
Esteban Ibáñez et al., 2020 Spain	Quantitative, descriptive and cross-sectional study	It aimed to analyze the sustainable development's incorporation of the Sustainable Development Goals (SDGs) in the university from the environmental education approach	Nonprobability sampling 1471 students	Questionnaire $\alpha - 0.977$	Findings suggest that students consider that environmental education is required to tackle environmental issues and to achieve sustainable development	82
Van Dongen, C. J. 2002 USA	Mixed method	It aimed to develop and implement a survey for Registered Nurses (RNs) that investigated beliefs related to the environmental health (EH) and nursing practice, preparation, barriers, factors that facilitate EH integration into nursing practice	Stratified random sampling 173 RNs	Survey $\alpha - 0.75$ (values were greater than 0.8)	Findings revealed that RNs believed that the environment influences health and EH; They also felt poorly prepared to address EH issues; Also, RNs felt uncertain concerning the EH knowledge base; As for facilitation, they were interested in including EH concepts in EH programs accessible in the workplace or through distance learning. Qualitative analysis identified major themes such as lack of EH content in nursing education, worry about pollution, and heavy workload to name a few	88

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Author/year/ country	Design	Aim of the study	Sample population	Name of the Tool Validity and reliability of the tool	Key findings	Score %
Cruz et al., 2018a Arab region	Quantitative, cross-sectional descriptive-comparative design	It aimed to assess the attitudes of nursing students toward climate change and environmental sustainability and their inclusion in the nursing curricula. It also examined the factors influencing the students' attitudes	Convenient sampling 1059 full-time Bachelor of Science in Nursing (BSN) students	SANS-2 questionnaire $\alpha - 0.89$	Findings revealed that the inclusion of climate change and environmental sustainability in the nursing curricula was crucial. As for factors, the residence, type of community, and knowledge about environmental issues and their influence on health in nursing course had an impact on the attitudes and views of nursing students toward climate change, environmental sustain ability, and their inclusion in the nursing curricula of Arab countries	90
Wang et al., 2022 Pakistan	Quantitative study	It aimed to understand university students' intention to use reusable drink cups in university campuses	Purposive sampling 361 students	Questionnaire $\alpha - 0.70$ (values were greater than 0.7)	Findings emphasize that promoting green initiatives at the institutional level fosters pro-environmental behavior. Also, it highlights that Pakistani univer sities have increased the sense of responsibility and ability to contribute to the environment's sustainability	82
Moustafa Saleh, M. S., & Elsabahy, H. E. S. 2022 Saudi Arabia and Egypt	Quantitative, quasi-experimental, cross-sectional and comparative study	It aimed to investigate the Integrating Sustainability Development Education Program in Nursing to challenge practice among nursing interns in healthcare	Systematic random sampling for Egyptian nursing interns (ENIs) Convenience sampling for Saudi nursing interns (SNIs) 160 nursing interns	Sustainability consciousness ques tionnaire (SCQ) developed by Gericke et al., 2019 and Ebrahim Elshall et al., 2022 Sustainability Attitudes in Nursing Survey (SANS-2) developed by Richardson et al., 2015 and Richardson et al., 2016 $\alpha - 0.82–0.86$	Findings revealed that Sustainability Development Education Program in Nursing significantly influenced ENIs and SNIs' knowledge, attitude, challenge practice and behavior as well as on all sustainability domains after sustainability development educational intervention	82

Gray et al., 2021 USA	Mixed methods study	It aimed to evaluate an instrument designed to help educators understand the baseline knowledge and self-efficacy of populations they engage	Convenience sampling 47 participants (undergraduate students and residents of communities with contaminated well water)	Survey Focus group $\alpha - 0.61{-}0.88$	Findings revealed that students scored higher than community residents. Many were challenged to know whether the water was safe for other uses. Overall, it indicated important environ mental health concepts, including hazard, exposure routes, vulnerable populations, and self-efficacy	72
Tabuenca et al., 2019 64 different countries	Quantitative study	It aimed to investigate the potential of massive open online courses (MOOCs) to spread environmental education	Sampling strategy not specified 3632 learners registered in the Spanish language MOOC on Marine Litter	Pre-questionnaire and post- questionnaire $\alpha - 0.84$ (values were greater than 0.8)	Findings emphasized that MOOCs are useful instruments to promote environmental activism, and to develop local solutions to global problems such as clean beaches, supplanting plastic bottles, educational initiatives, and prohibition of single-use plastic	74
Amador-Alarcón et al., 2022 Mexico	Quantitative, descriptive and cross-sectional design	It aimed to understand the perceptions of university students about the environmental problems related to the use of digital technologies and devices	Non-probabilistic sam pling 135 students	Questionnaire $\alpha - 0.75$	Findings highlight that most students are aware that the use of digital devices for educational purposes has an impact on the environment and that, therefore, it is essential to adopt effective measures and habits for adequate and optimal use of digital environments	80
Cruz et al., 2018b Saudi Arabia	Quantitative, cross-sectional and descriptive study	It aimed to investigate the predictors of Saudi nursing students' attitudes towards the environment and sustainability in healthcare	Convenience sampling 280 nursing students	New Ecological Paradigm (NEP) Scale Sustainability Attitudes in Nursing Survey 2 (SANS-2) $\alpha - 0.83$ for (NEP) $\alpha - 0.82$ for SANS-2	NEP score indicated moderate pro-environment attitudes SANS-2 emphasized very positive attitudes towards sustainability in healthcare. Learning about the environment and related issues in the nursing program, raising climate change awareness and attending environment-related seminars and training positively impacted the environmental and sustain ability attitudes of nursing students	78

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Author/year/ country	Design	Aim of the study	Sample population	Name of the Tool Validity and reliability of the tool	Key findings	Score %
Ling et al., 2020 USA	Quantitative, quasi-experimental study	It aimed to identify the demographic antecedents to environmental worldview in higher education students. It investigates the effects of different higher education pedagogies on environ mental worldview across academic programs. It also examines what factors are significant predictors of the nature of any detected change in envi ronmental worldview	Sampling strategy not specified Metadata set generated from matched surveys of students at a large public university	Survey $\alpha - 0.76–0.82$ (including pretest and posttest results)	Findings suggest that factors associated with environmental worldview upon commencement of a course do not necessarily predict the malleability of that worldview in higher education students	78
Clery et al., 2021 England	Mixed methods sequential explanatory study	It aimed to develop and evaluate a sustainability in quality improvement (SusQI) teaching using this toolkit at Bristol Medical School	Sampling strategy not specified 342 third-year undergrad uate medical students	Pre-and post-session evaluation questionnaires $\alpha - 0.86–0.91$	Findings indicated improvements in knowledge, confidence, and attitudes in both sustainable healthcare and quality improvement. Factors for successful teaching included: interactivity, collaboration and participation; and real-life, relevant and tangible examples of projects delivered by credible role models	80
Gupta et al., 2022 UK	Quantitative, descriptive study	It aimed to investigate the perspectives of medical students in the UK regarding current and future incorporation of education for sustainable healthcare (ESH) in medical education	Sampling strategy not specified 163 medical students	Survey None	Findings revealed that 93% of students believed that climate change is a concern in current society, and only 1.8% thought they have been formally taught what sustainable healthcare is. 89% agreed that more ESH is needed whereas 60% believed that future teaching should incorporated in both preclinical and clinical years, with 31% preferring online modules as the method of teaching	80

Barragán-Sánchez et al., 2020 Spain	Quantitative study	It aimed to design a valid, reliable and useful scale to measure self-perceived teacher digital competence regarding the eco-responsible use of technologies	Convenience sampling 778 teachers	Questionnaire α − 0.979 and McDonald's Omega index − 0.981	Findings suggest the reliability and validity of the model. The need to establish environmental teacher training plans an more awareness about the eco-responsible use of technologies is established	80
Otsuka et al., 2018 Japan	Quantitative study	It aimed to grasp conceptions of environmental learning and validate a scale for this purpose	Sampling strategy not specified 771 high school students	Survey α − was calculated for each of the six factors. Factor 1 α − 0.90 Factor 2 α −0.78 Factor 3 α − 0.76 Factor 4 α − 0.64 Factor 5 α − 0.65 Factor 6 α − 0.50	Findings indicated that students' conceptions of learning consist of six orientations: (1) Environmental recognition/Conservation/Responsibility orientation, (2) Thought expansion/fulfillment, (3) Certainty/Applicability orientation, (4) Teacher-dependent orientation, (5) Experience-based physical activity orientation, and (6) Duty-adjusted orientation	80
El-Zein et al., 2006 Lebanon, Beirut	Mixed methods, priority-sequence design with a small qualitative component	It aimed to investigate the explanatory capability of five "contextual" groups of variables: socioeconomic status, locality, behavior, health, and environmental beliefs	Systematic random sampling 110 household participants	Survey Semi-structured interviews None	Findings suggest that while socioeconomic, locality, behavioral and health variables explain some priorities but not others, environmental belief variables are present as significant predictor of all priority variables	82

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