

ECO-EDUCATION TRANSFORMATION TOWARDS GREEN HUMAN RESOURCES FOR HEALTH: INTEGRATING ECOLOGICAL LITERACY, ENVIRONMENTAL ETHICS, CRITICAL THINKING, AND MENTAL HEALTH RESILIENCE FOR SUSTAINABLE HEALTHCARE

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ABSTRACT

Background: Climate change, environmental degradation, pandemics, and humanitarian crises have significantly affected healthcare systems worldwide. These challenges require healthcare professionals who possess not only clinical competencies but also sustainability-oriented skills, ecological awareness, and psychological resilience. However, environmental literacy and resilience competencies remain insufficiently integrated into health professional education.. **Objectives:** This study aimed to explore the role of eco-education in transforming health professional education and to propose a Green Human Resources for Health (GHRH) framework that integrates ecological literacy, environmental ethics, critical thinking, and mental health resilience. **Methods:** A narrative literature review was conducted using publications from 2020–2025 obtained from Scopus, Web of Science, PubMed, ScienceDirect, SpringerLink, and Google Scholar. Relevant literature related to eco-education, sustainability, environmental ethics, climate-health education, resilience, and workforce development was analyzed thematically. **Results:** The review identified four essential competencies required for future healthcare professionals: ecological literacy, environmental ethics, critical thinking, and mental health resilience. Eco-education was found to be an effective approach for strengthening these competencies. The proposed GHRH framework positions eco-education as the foundation for developing environmentally responsible, critically reflective, and resilient healthcare professionals capable of supporting sustainable healthcare systems. **Conclusions:** Eco-education provides a strategic pathway for transforming health professional education. Integrating ecological literacy, environmental ethics, critical thinking, and mental health resilience can contribute to the development of Green Human Resources for Health and support sustainable healthcare systems and global recovery efforts.

Keywords: Eco-Education; Green Human Resources for Health; Ecological Literacy; Environmental Ethics; Mental Health Resilience; Sustainable Healthcare

INTRODUCTION

Climate change has emerged as one of the greatest threats to global public health in the twenty-first century. According to the World Health Organization (WHO, 2021), climate-related events contribute to increased mortality, food insecurity, infectious diseases, mental health disorders, and disruptions in healthcare delivery. Environmental degradation, biodiversity loss, and pollution further intensify these challenges and disproportionately affect vulnerable populations.

The COVID-19 pandemic highlighted weaknesses within healthcare systems worldwide. Healthcare professionals experienced substantial psychological burdens, including burnout, anxiety, and occupational stress (Labrague, 2021). Similar conditions have been reported during natural disasters, humanitarian crises, and climate-related emergencies. These circumstances indicate that future healthcare professionals require broader competencies beyond clinical expertise.

Environmental factors increasingly influence disease patterns and healthcare outcomes. Rising temperatures, extreme weather events, air pollution, and ecosystem disruption contribute to emerging health risks and greater healthcare demands (Romanello et al., 2024). Consequently, healthcare professionals must understand environmental determinants of health and contribute to sustainable healthcare solutions.

Sustainable healthcare has become a global priority. Sustainable healthcare systems aim to provide high-quality services while minimizing environmental impacts and ensuring resource availability for future generations (Karliner & Slotterback, 2022). Achieving these goals requires a healthcare workforce equipped with sustainability competencies.

Educational institutions play a vital role in preparing future healthcare professionals. However, many health professional curricula remain heavily focused on biomedical and clinical sciences, with limited emphasis on sustainability, environmental responsibility, and resilience development (Lemery et al., 2024). This educational gap may limit healthcare professionals' ability to respond effectively to emerging environmental and public health challenges.

Eco-education offers a promising solution by integrating sustainability principles, ecological literacy, environmental ethics, and critical thinking into educational systems (UNESCO, 2024). Therefore, this study proposes the Green Human Resources for Health (GHRH) framework as an innovative model for transforming health professional education toward sustainability, resilience, and global recovery.

METHODS

This study employed a narrative literature review design. Literature was collected from Scopus, Web of Science, PubMed, ScienceDirect, SpringerLink, and Google Scholar databases. Publications published between 2020 and 2025 were prioritized to ensure relevance to current developments in sustainability and healthcare education.

Keywords used during the search process included “eco-education,” “ecological literacy,” “environmental ethics,” “mental health resilience,” “Green Human Resource Management,” “health workforce,” “climate-health education,” and “sustainable healthcare.”

Selected articles were analyzed using thematic analysis. Themes were grouped into ecological literacy, environmental ethics, critical thinking, mental health resilience, and sustainable workforce development. The findings were synthesized to develop the Green Human Resources for Health (GHRH) conceptual framework.

RESULT

Green Human Resources for Health Framework

The literature review identified four key competencies required for future healthcare professionals to address emerging environmental and public health challenges: ecological literacy, environmental ethics, critical thinking, and mental health resilience. These competencies were consistently highlighted across studies discussing sustainable healthcare, climate-health education, workforce resilience, and sustainability-oriented learning.

Table 1. Synthesis of Literature Supporting the Green Human Resources for Health (GHRH) Framework

Author	Main Focus	Contribution to GHRH
Orr (1992)	Ecological Literacy	Foundation of ecological literacy competency
Renwick et al. (2013)	Green Human Resource Management	Foundation for workforce sustainability
Wals & Benavot (2017)	Sustainability Education	Critical thinking development
Labrague (2021)	Psychological Resilience	Mental health resilience
Karliner & Slotterback (2022)	Sustainable Healthcare	Environmental responsibility
UNESCO (2024)	Eco-Education	Educational transformation

Lemery et al. (2024)	Climate-Health Education	Curriculum reform
Romanello et al. (2024)	Climate and Health	Workforce urgency

The findings indicate that eco-education serves as a strategic mechanism for integrating sustainability competencies into health professional education. The reviewed literature consistently demonstrates that environmental awareness, ethical responsibility, critical thinking, and resilience are increasingly important for healthcare professionals operating in rapidly changing environments.

Table 2. Core Competencies of Green Human Resources for Health

Competency	Description	Expected Outcome
Ecological Literacy	Understanding environmental determinants of health	Environmental awareness
Environmental Ethics	Responsible environmental decision making	Sustainable healthcare behavior
Critical Thinking	Evidence-based analysis and problem solving	Improved professional judgment
Mental Health Resilience	Adaptation during crises and emergencies	Workforce sustainability

Based on the literature synthesis, a conceptual framework was developed to illustrate the pathway through which eco-education contributes to sustainable healthcare workforce development.



Figure 1. Conceptual Framework of Green Human Resources for Health (GHRH)

The framework demonstrates that eco-education functions as the driving force for developing sustainability competencies among healthcare students. These competencies collectively contribute to the formation of Green Human Resources for Health capable of supporting sustainable healthcare systems and global recovery initiatives

DISCUSSION

Eco-Education as a Driver of Educational Transformation

The findings suggest that eco-education represents an important strategy for transforming health professional education. Traditional educational models often emphasize clinical competencies while giving limited attention to sustainability-related issues. However, environmental challenges increasingly influence population health and healthcare delivery. Consequently, future healthcare professionals require broader competencies that include ecological awareness, sustainability principles, and adaptive capacity.

Eco-education promotes transformative learning by encouraging students to understand the interconnectedness of environmental, social, and health systems. This educational approach supports systems thinking and enables learners to address complex problems that cannot be solved through disciplinary knowledge alone. As healthcare systems face growing environmental pressures, eco-education provides a foundation for preparing professionals capable of responding effectively to sustainability challenges.

Ecological Literacy and Environmental Ethics in Healthcare

Ecological literacy emerged as a fundamental competency within the proposed framework. Healthcare professionals increasingly encounter environmental determinants of health, including climate-related illnesses, pollution-related diseases, food insecurity, and disaster-related health risks. Understanding these relationships enables healthcare professionals to participate more effectively in prevention, advocacy, and health promotion efforts.

Environmental ethics complements ecological literacy by providing a moral foundation for environmentally responsible healthcare practices. Sustainable healthcare requires consideration of both patient outcomes and environmental impacts. Therefore, integrating environmental ethics into health professional education can strengthen commitment to environmental stewardship and sustainability-oriented decision-making.

Critical Thinking for Sustainable Healthcare

Critical thinking plays a central role in addressing environmental and public health challenges. Sustainability-related issues are often characterized by uncertainty, complexity, and competing priorities. Healthcare professionals must therefore evaluate evidence critically and make informed decisions under changing circumstances.

The literature indicates that eco-education strengthens critical thinking by encouraging analysis, reflection, and problem-solving. Through sustainability-focused learning experiences, students learn to examine environmental challenges from multiple perspectives and develop evidence-based solutions. These competencies are essential for supporting innovation and adaptability within healthcare systems.

Mental Health Resilience and Workforce Sustainability

Mental health resilience is increasingly recognized as a critical component of healthcare workforce development. The COVID-19 pandemic demonstrated that healthcare professionals are highly vulnerable to stress, burnout, and psychological distress during crises. Similar challenges are expected to increase due to climate-related disasters and humanitarian emergencies.

Resilience enables healthcare professionals to maintain performance and psychological well-being under demanding conditions. Educational institutions therefore have an important role in fostering resilience through supportive learning environments, reflective practice, emotional intelligence development, and stress management training. Strengthening resilience contributes directly to workforce sustainability and healthcare quality.

Implications of the Green Human Resources for Health Framework

The proposed GHRH framework extends previous discussions on Green Human Resource Management by applying sustainability principles specifically to health workforce development. Unlike traditional workforce models that focus primarily on technical competencies, GHRH emphasizes sustainability-oriented competencies required for future healthcare practice.

At the educational level, the framework supports curriculum transformation and competency-based learning. At the organizational level, it promotes sustainable workforce development and environmentally responsible healthcare practices. At the societal level, it contributes to healthcare system resilience, environmental sustainability, and global recovery efforts.

The framework also aligns with several Sustainable Development Goals, including SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals). Therefore, integrating the GHRH framework into health professional education represents a strategic investment in sustainable healthcare and future workforce preparedness

CONCLUSIONS

Climate change, environmental degradation, and global health emergencies have transformed the competencies required of healthcare professionals. Traditional health professional education is no longer sufficient to prepare future healthcare workers for these emerging challenges.

This study proposes the Green Human Resources for Health (GHRH) framework as a sustainability-oriented model for workforce development. The framework integrates ecological literacy, environmental ethics, critical thinking, and mental health resilience through eco-education transformation.

The integration of these competencies can contribute to sustainable healthcare systems, workforce resilience, and global recovery efforts. Educational institutions, policymakers, and healthcare organizations should therefore incorporate sustainability competencies into health professional education and workforce development strategies.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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AUTHOR CONTRIBUTIONS

RAD: Conceptualization, methodology, literature review, formal analysis, writing-original draft, review and editing.

LRVS: Validation, supervision, review and editing.

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