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Review Article

Towards Greening the Higher Education Curricular for Sustainable Development: The Zimbabwe Context

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Abstract
Planet Earth is grappling with the pangs of climate change and natural disasters across the globe. Humanity has to keep pace with the ever-changing socio-economic and natural challenges and plan for a sustainable future. Environment conservation is paramount for sustainability. It is against this backdrop that this study was carried out. The main thrust was to develop sustainable strategies to be employed by Higher Education Institutions (HEIs) in a bid to spearhead environment conservation and natural disaster risk management in communities for a more sustainable future. HEIs can leverage their academic muscles and modern technological tools like Artificial Intelligence (AI) and the Internet of Things (IoT) to green their curricula, pedagogies, and assessment mechanisms to produce conservation astute graduates who can generate practical knowledge-driven solutions to societal problems and generate socio-economic empowerment from the natural resources abound in Zimbabwe, leveraging on the Heritage based Education system anchored on Education 5.0 which emphasizes industrialization and innovation. The study employed the Hermeneutic Phenomenology design situated in the interpretivist paradigm and used systematic literature review, and document analysis to collect data which was thematically analysed to design a framework for greening the curricula across different learning disciplines, especially those not directly linked to environmental issues. The study also envisaged a holistic approach incorporating various stakeholders within and without education circles. Conclusions drawn include the prospect of making HEIs vehicles for change and awareness creation by effecting the curriculum development strategies suggested. Recommendations include explicitly including environmental issues in all curricula, and engaging in multi-sectoral collaboration among curriculum designers, policymakers, examination bodies, and community personnel. The second part of the research focussed on presenting a framework that STEM educators can use to green their modules. The researchers argue that if every module is green then the whole curriculum would be green.

Keywords: Curriculum Development, Environmental Conservation, Green Curriculum, Green Education, Heritage-Based Education, Sustainable Development

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1. INTRODUCTION

The world is grappling with the pressing challenges of climate change (CC) and natural disasters, which are increasingly negatively impacting societies and economies worldwide. Climate change and natural disasters pose significant threats to human well-being and ecosystem health. The Intergovernmental Panel on Climate Change (IPCC) (2021) highlights the urgent need for global action to mitigate greenhouse gas emissions and adapt to the changing climate. Natural disasters, such as floods, droughts, and cyclones, can have devastating consequences, particularly for vulnerable communities, for example rural Zimbabwe.

Recent studies have shown that climate change is taking place globally including Africa in general and Zimbabwe in particular. Fig 1.1 highlights some statistics from a survey carried out in Zimbabwe. This shows that only 45% of the population is aware of climate change and most of these people believe that CC is increasingly making life worse for citizens. A majority of people believe that the government is mostly responsible for mitigating the effects of CC, and only 36% of people believe that ordinary citizens have a role to play in this crisis. Education thus has a role to play in both increasing awareness among people and in coming up with knowledge-based solutions that engage the general populace and other relevant stakeholders.

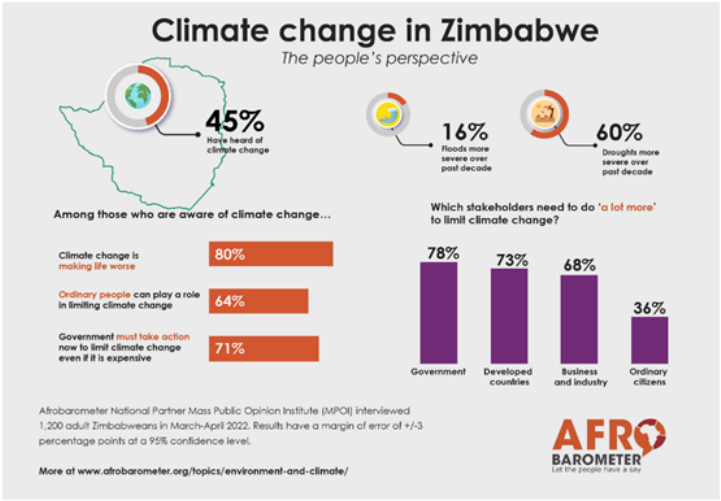

Figure 1. Zimbabwe Climate Change Country Card, Afrobarometer (2022)

This paper argues that Higher Education Institutions (HEIs) have a pivotal role to play in addressing these issues by fostering a culture of environmental consciousness and sustainability by leaning on its vast intellectual and research personnel and resources. This study aims to explore the potential of HEIs in spearheading environment conservation and natural disaster risk management in communities by greening the academic curriculum. Graduates from such an education system will be able to provide knowledge-based solutions to societal problems with a focus on Zimbabwe. HEIs have been recognized as key actors in promoting sustainable development and environmental stewardship (UNESCO, 2021). By integrating sustainability into their curricula, research, and operations, HEIs can equip students with the knowledge and skills needed to address environmental challenges. Additionally, HEIs can contribute to community resilience by engaging in outreach activities, partnerships, and knowledge transfer. (Lotz-Sisitka et al., 2022).

UNESCO envisages that by 2030, 90% of the countries in the world should have green curricula. 70% of global young people say they are not climate-ready based on their current education experiences. 47% of national curriculum frameworks of about 100 countries did not refer to climate change. Against this backdrop, Zimbabwe must step up its game and possibly lead the world in coming up with a sustainable green HEI curriculum. This study aims to provide a workable and understandable framework for creating such curricula for Zimbabwean HEIs and possibly adaptable by the rest of the world. UNESCO has spearheaded the challenge by advancing a six-section framework anchored on the three pillars-Environmental (climate science and ecosystems and biodiversity); Social (climate justice and resilience building; and Economic (post-carbon economies and sustainable lifestyles). (UNESCO, 2021).

The concept of Education 5.0, which emphasizes human-centered teaching/learning, research, community service, innovation, and industrialization provides a framework for HEIs to adopt a more holistic approach to education, sustainability, and entrepreneurship. By incorporating Heritage-Based Education, which draws on local cultural and historical resources, HEIs in Zimbabwe can foster a deeper connection to the environment and promote sustainable practices by implementing innovation hubs and industrial parks to add value to existing natural resources. An assessment of existing curricula in most STEM learning areas like Physics and Mathematics has revealed that environmental preservation and sustainability

issues are either absent or are not explicitly addressed (UNESCO, 2021; Alharbi, 2023; Martinez & Wong, 2023; Togo & Gandidzanwa, 2021).

Zimbabwe has a unique socio-economic and cultural landscape that influences educational practices. Phenomenology allows researchers to explore how local cultural values, historical contexts, and socio-political factors shape perceptions of sustainability in higher education. This contextual understanding is essential for developing relevant and effective curriculum changes.

The paper envisions highlighting the pivotal role that HEIs can play in facilitating sustainable development and crafting a framework for designing green curricula for STEM learning areas not directly linked to environmental studies for example Physics. The researchers hope to provide scope for designing a generic framework that can be applied across different learning areas.

1.1. Literature Review

1.1.1. The Role of HEIs in Environmental Conservation and Disaster Risk Management

Zimbabwe has experienced several cyclones in the past two decades, including Cyclone Eline (2000), Cyclone Japhet (2003), Cyclone Dineo (2017), Cyclone Idai (2019), Tropical Storm Chalane (2020), Cyclone Eloise (2021), Cyclone Ana (2022), and Cyclone Freddy (2023). This situation has made ecological sustainability a top priority, necessitating the involvement of all stakeholders. Research shows that current laws and structures for climate change management do not include provisions for the participation of higher education institutions (HEIs). Additionally, participants expressed mixed opinions on the role of HEIs in climate change and disaster management. (Macheka, 2024).

Globally, SDG4 envisions that by 2030 there will be all-encompassing and equitable quality education to support lifelong learning prospects for all (Dzvimbo et al., 2022; Mawonde & Togo 2019). The United Nations Department of Economic and Social Affairs (UN 2016) highlighted the need for partnerships among governments, citizenry, and the private sector to accomplish available development programs. As such, higher education institutions (HEIs) teaching, learning, research, innovation, and community engagement need to be considered driver for implementing SDGs to reduce the impact of climate-induced natural disasters (CINDs).

Several scholars in Zimbabwe have emphasized the important roles that higher education institutions (HEIs) can play in addressing ecological challenges. A study by Kupika et al. (2020) focused on a University of Technology in Zimbabwe, revealing that faculty members engage in collaborative research and community outreach initiatives, significantly contributing to climate change science, adaptation, mitigation, and resilience in Africa. The researchers suggested that the Government of Zimbabwe could adopt the University as a model for translating climate-related research into actionable policy by enhancing collaboration between academics and stakeholders. Community engagement is equally important in this endeavour. Organizing workshops, seminars, and training programs empowers communities to take proactive steps regarding environmental issues and disaster risk reduction. Establishing partnerships with NGOs, community-based organizations, and government agencies can further strengthen the impact of efforts made by higher education institutions. Moreover, encouraging student involvement in community projects fosters a sense of civic responsibility and contributes to sustainable development, ensuring that future generations are prepared to tackle environmental challenges head-on. (Kupika et al., 2020).

Curriculum integration is vital in fostering environmental awareness and responsibility among students. Educators can cultivate a broader understanding of climate change and disaster risk management by incorporating environmental education into various disciplines- beyond just environmental science. Offering specialized courses equips students with essential knowledge and skills to tackle challenges associated with these pressing issues. Additionally, interdisciplinary approaches encourage collaboration among different academic fields, leading to innovative solutions that effectively address complex environmental and social problems.

In the realm of research and innovation, it is crucial to conduct studies focused on the impacts of climate change, vulnerability assessments, and adaptation strategies. Such research can inform policymaking and support evidence-based planning. Similarly, investigating disaster risk factors, developing early warning systems, and exploring community-based disaster responses contribute significantly to effective risk

management. The application of innovative technologies—such as remote sensing, Geographic Information Systems (GIS), and artificial intelligence (AI)—can enhance monitoring, early warning capabilities, and overall response efforts.(Inpin et al., 2023).

1.1.2. Rationale for a Phenomenological Study Design

A phenomenological design is an ideal approach to investigate the topic "Towards Greening the Higher Education Curriculum for Sustainable Development: The Zimbabwean Context." This method allows researchers to delve deeply into the lived experiences of individuals, providing rich, contextualized insights into the phenomenon under study. This methodology allows the researcher to gain a more realistic view of the phenomenon first hand from those who live through it and experience it. (Mhatre & Mehta, 2023).

Qualitative research offers valuable advantages for exploring complex social phenomena. One of its key benefits is flexibility; researchers can adapt interview questions in real time based on the conversation and unique insights from participants. This adaptability allows for the exploration of unexpected themes, resulting in richer data. The focus of qualitative research is to capture the lived experiences of individuals. By engaging deeply with participants through open-ended interviews, researchers can uncover the emotions and meanings behind their stories. This approach not only allows for a comprehensive understanding of the phenomenon being studied but also highlights the nuances in participants' narratives. Another significant advantage is that qualitative research does not require large sample sizes. This is especially useful in exploratory studies, as smaller samples facilitate closer interactions and foster a sense of trust, encouraging participants to share meaningful insights. Moreover, qualitative research emphasizes the importance of non-verbal cues—such as body language and facial expressions—which add depth to participants' experiences. These cues can provide important context, helping researchers gain a fuller understanding of what participants convey.

Lastly, phenomenological designs contribute to theory development by providing rich, contextual data that can lead to new insights or refinements of existing concepts. Overall, qualitative research captures the complexities of human experiences, significantly enriching our understanding of the social world. (Mhatre & Mehta, 2023, Oranga & Matere, 2023).

Twenty-first century competencies and pro-environmental behaviour are inadequately integrated into educational institutions and workplaces. A 2016 Yale University study found that 65% of the Indian population is unaware of climate change. The United Nations has established the Millennium Development Goals (MDGs) and the Decade of Education for Sustainable Development (ESD) to address these issues. Urgent incorporation of climate change education and sustainable development principles into curricula is essential to tackle future challenges. Children, youth, professionals need to imbibe greener values such as adopting gardening, Reconnect with Nature, sustainable living to maintain the environmental balance, under the action plan of environmental protection, conservation of environment, and to create the awareness among citizens for Greening Education, and promoting ESD. (YALE, 2016 Garg & Agarwal, 2021).

1.1.3. Framework for Designing a Green STEM Course Outline

A green STEM curriculum should integrate sustainability principles into traditional STEM subjects, fostering a generation of environmentally conscious problem-solvers. Fig 1.2 shows the Key principles of greening designed by UNESCO. This paper aims to interpret and give insights into how these principles can be fused into the Zimbabwean academic curriculum. To promote sustainability education (HEIs) are expected to assume more responsibility in imparting environmental knowledge and values, nurturing innovative solutions, and actively providing input in policy development. HEIs are regarded as micro-ecosystems of society and should therefore promote inclusivity and quality education to ensure national and global development and emancipation. Policymakers should therefore consult stakeholders in education to enact sound and environmentally friendly policies that are not purely political. (Purcell et al., 2019; Muposhi et al., 2022; Shamhuyenhanzva, 2024).

A sustainable education system is a prerequisite for national development. By providing students with green skills and knowledge to adapt to this dynamic and rapidly changing world, it empowers them to become productive citizens (socio-economically and technologically). Through innovative teaching /learning pedagogies and a focus on practically applicable skills, it equips students to contribute to Zimbabwe's Vision 2030 of achieving an upper middle-income economy. By optimizing resource allocation (human and material), adding value to vast natural resources, and actively promoting sustainability, it ensures the long-term success of the education system and the nation as a whole (Chinokopota et al., 2024).

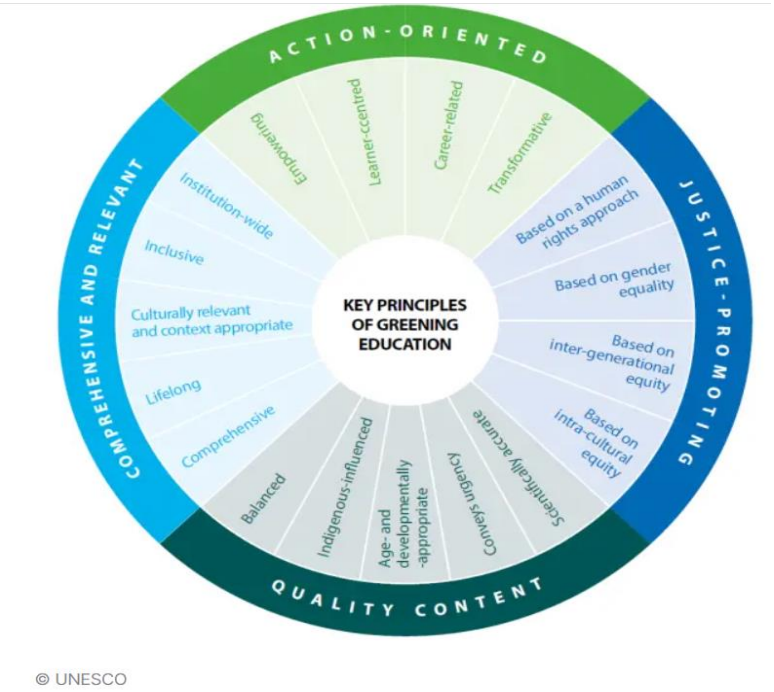

Figure 2. Key Principles of Greening Education, UNESCO (2021)

There are four key pillars: Comprehensive and relevant; Action-oriented; Justice Promotion; and Quality content. Each key component is split into several sub-components. In many learning areas, it may not be possible to fit these components in all topics in the course outline. A possible way is to assess the course outline and fit one relevant sub-component in each topic and give locally based examples. For example, when teaching about the periodic table of elements in Chemistry, examples of locally occurring elements like gold, chrome, and uranium may be given.

In multicultural classes, social justice can be infused by promoting intercultural collaborations in classwork and discussions. Every student should be given respect and allowed to enjoy their rights as students and as human beings. An example can be given from the Electronics module in Physics which at a glance appears not to have any social justice issues. The educator can be innovative and explain the circuit laws and theorems as instruments of maintaining order and systematic scientific behaviour just like the constitutional laws that govern society (the science fraternity is a society, and the classroom is a society…). Topics on amplifiers, rectifiers, logic gates, and so on have strong social implications. These components are manufactured using elements and minerals of which some are locally available. Modern technological gadgets used by students in daily life for learning and entertainment apply electronics. Modern lighting systems use light-emitting diodes (LEDs) which conserve energy more than traditional light bulbs. This is an example of greening the Physics curriculum. When discussing gravitation, it can be stated that the whole universe is connected by gravitational forces governed by some laws, the universe is a system of interacting bodies, the whole world is a global village, everyone has the right to enjoy quality life, plants, and animals also have rights to live in this village-environmental issues thus easily come into play.

The class can explore notions that the global village is inclusive of everyone from different socio-economic, cultural, and ethnic backgrounds. Careers related to the topic can be explored in depth. This makes education a high-quality, comprehensive, and relevant commodity. In this example, all aspects of the UNESCO principles have been incorporated. This can be done on all topics in different modules. If a

module has say ten topics, if the educator picks at least one key principle per topic, at the end of the semester they would have covered ten components of the principles of greening the curriculum, and a mammoth task would have been achieved. To design a holistic sustainable and working module, students have to be consulted to keep up with current trends and map the way forward for a brighter future with ongoing improvements (Anderson, 2021; Hughes, 2022; Johnson et al., 2023).

In some learning areas, sustainability themes cannot be easily incorporated into existing curricula. In this case, new units that explicitly address these themes can be drafted into the learning area modules. In some HEI departments, for example, STEM-based learning areas like Physics, chemistry, biology, and mathematics it may be sensible to identify cross-cutting environmental issues and create common modules for several learning disciplines. However, other scholars in Zimbabwe have identified positive roles of HEIs in ecological issues. Kupika et al. (2020) conducted a study focusing on a University of Technology in Zimbabwe. The researchers found that, in addition to offering degree programs, some academics at the university collaborate internally and with external stakeholders on research activities and community programs. These initiatives contribute to climate change science, adaptation, mitigation, and resilience efforts in Zimbabwe and Africa. The researchers suggested that the Government of Zimbabwe (GoZ) could use the University as a model for translating climate-related research into policy and action by fostering linkages between academics and other stakeholders for climate-smart development initiatives (Kupika et al., 2020).

Teaching and learning pedagogies can be modified to incorporate active learning practices that promote collaborations between students and other stakeholders to solve real societal problems for example the supply of alternative green energy to mitigate current electricity outages in most parts of Zimbabwe and the supply of clean drinking water. Among the teaching and learning objectives for each lesson, at least one of them should explicitly address an environmental issue. If this is done in every lesson, sustainability education will gradually become a new learning culture and this will go a long way towards practicing environment stewardship and educating the community at large on environmental conservation and natural disaster risk management. Stakeholders involved in public service delivery in the context of disaster risk reduction for sustainable human security include government agencies, emergency services, community organizations, academic and research institutions, the private sector, and the media. (Chibhoyi et al., 2024; Chapungu & Nhamo, 2024).

On justice promotion, one key element is gender equality. It is of note that in many STEM learning areas, females are usually less than males. This could be due to traditional and societal stereotypes that portray males as more capable than females to excel in STEM-based learning areas and career paths. Educators need to dispel this myth and find examples of local and outside-based female role models who have excelled. The teaching methodology to be used could involve inviting relevant resource persons (particularly females) to motivate the female student and downplay the myth and stereotype. Studies have also shown that gender disparities persist in informal innovation spaces, as women make inroads into the historically male-dominated realm of metal fabrication within the informal economy. Embedded biases, stigma, ridicule, and abuse continue to haunt female participants. HEIs need to craft a curriculum that attracts women and girls. Gender equality issues can be explicitly included in STEM and TVET curricula as cross-cutting issues, they could be either added within carefully selected modules or taught as stand-alone modules. (Manyati et al., 2024).

In response to the climate emergency and future Sustainable Development (SD) of our planet, HEIs must adopt integrated, holistic approaches to curriculum design that are primarily focused on developing graduates into more socially responsible, global citizens and engineers with sought-after sustainability competencies and skills, empowered to tackle complex local and global SD challenges. This could be achieved by clearly and explicitly fusing social justice issues into STEM curricula along the principles of human rights respect, the spirit of Ubuntu/Hunhu that emphasizes mutual inter-generational equity and respect for indigenous knowledge systems. The modern education system should also acknowledge the contribution of people from different cultural backgrounds with no favour to achieve intercultural equity and collaboration. If possible, care must be taken to research and give examples on any topic that are culturally relevant and resonate with the backgrounds of learners so that learning becomes a part of everyday life and a shaper of future sustainable career prospects. This also espouses the pillar of comprehensive and relevant education, Quality education, and Action-oriented to empower learners to actively contribute

towards a global environmentally friendly future with the ability to provide knowledge-driven solutions to societal problems. (Doss, Poursharif, 2024).

To address quality content, modules should have an Indigenous influence, and the examples given should apply to the local perspective. For example, in a Physics topic renewable energy, emphasis can be put on recent power outages in Zimbabwe and a need to embrace alternative green energy like investing in solar energy. Scientifically sound models, explanations, and justifications should be given according to the age and academic and social comprehension levels of the learners to make learners understand the urgency of suggested solutions and their practical applications in a world they can perceive and possibly come up with novel knowledge-driven solutions to real societal problems. Care must be taken in balancing local and global perspectives, and social, environmental, and economic connotations of decisions taken. (O' Donoghue et al., 2024).

The Action-oriented pillar requires giving students a holistic quality education experience that is comprehensive and relevant to their current environment and prepares them to actively participate in the future local and global environment which would be highly technologically driven. The curriculum thus has to be transformative and provide learners with scaffolding to empower them to smoothly transition from the current to the future world with confidence. Teaching and learning pedagogies should thus change to active learner-centered methods that promote the acquisition of 21st-century skills like communication, collaboration, problem-solving, and innovation among many others. The researchers are aware that different HEIs in Zimbabwe are at different levels in achieving the ultimate goals due to various socio-economic, cultural, and political reasons. As the adage goes, "Where there is a will, there is a way." (Poza-Vilches et al., 2022).

1.1.4. Methods of implementing a green Curriculum Framework

Figure 3 delineates four potential methodologies for the implementation of the green curriculum framework. The diagram is organized into four quadrants, each representing a distinct approach. This matrix is designed to be adaptable, enabling a combination of strategies and starting points tailored to the unique needs, resources, and priorities of institutions at any given time.

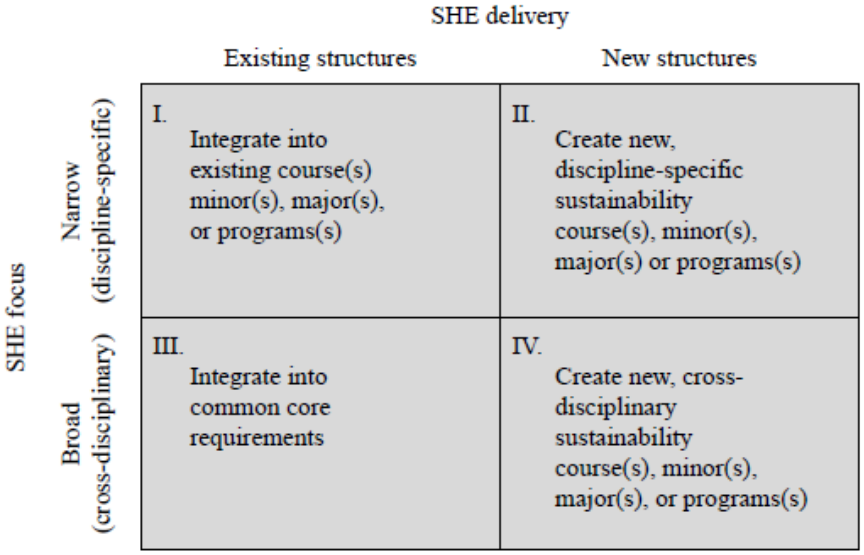

Figure 3. Generic Matrix for Administering Sustainable Higher Education (SHE), Rusinko (2010)

- Quadrant I: Incorporating sustainability and environmental sustainability issues into existing courses across specific disciplines, achieved through the addition of new modules, case studies, or topics.
- Quadrant II: Developing new courses or programs that are discipline-specific and focused on addressing sustainability and green issues.
- Quadrant III: Integrating sustainability matters into existing core courses that cut across multiple disciplines within a department or faculty.

- Quadrant IV: Establishing new, cross-disciplinary courses or programs that approach sustainability from various perspectives, potentially extending across the entire university or college (Rusinko, 2010).

2. METHODOLOGY

This study employed a Hermeneutic Phenomenological research design, which is well-suited for exploring lived experiences and understanding the complexities of social phenomena. Data was collected through a combination of literature review, document analysis, and open-ended questionnaires. Thematic analysis was used to identify key themes and patterns in the data. The steps followed are summarised in Figure 4.

Figure 4. Summary of the Research Design-Designed during the Research

A database search of keywords in peer-reviewed articles published from 2019 to 2024 was reviewed. Key research studies were selected for the integrative literature review. The key studies met the inclusion criteria of phenomenology. In hermeneutic phenomenology, the researcher uses interpretation to understand a phenomenon's experiences and interactions.

The research delved into a crucial topic: the greening of STEM curricula in higher education institutions (HEIs). To explore this phenomenon more thoroughly, we developed several open-ended research questions aimed at understanding the lived experiences and perceptions of those involved in this process. We chose a hermeneutic interpretive approach, which enabled us to gain deeper insights and create a framework for integrating sustainability into the curriculum.

To gather meaningful data, we focused on peer-reviewed academic sources, primarily from Google Scholar, Research Gate, Directory of Open Access Journals (DOAJ) and web searches that addressed environmental and sustainability issues, especially in the context of Zimbabwe. This literature review served as the foundation for our data collection, drawing from a variety of research studies published in journals, books, conference proceedings, and online resources.

2.1. Rationale for Drawing Data Mostly from These Data Sources

Without undermining the power and robustness of widely used academic databases like Scopus and Web of Science among others which provide high-quality peer-reviewed publications, these were consulted but not explicitly referred to due to the nature of the study which also required access to grey literature like institutionalized course outlines, theses, policy documents, Technical reports, preprints of some publications to show earlier versions of a paper and conference proceedings. These have very little coverage on some databases. Google Scholar provided much valuable information embedded in these types of documents. It also cross-referenced some publications on Web of Science and Scopus. These documents, often produced by think tanks and research organizations, are indexed by Google Scholar, offering insights

into specific issues and recommendations based on research. This particular study required intensive data review including findings from other researchers whose papers are not published on popular databases but are readily available on Google Scholar. Research Gate is a platform where researchers from different institutions, countries and subscribe to diverse databases and journals congregate to discuss pertinent academic issues and share publications and ideas. This becomes a great platform to obtain pivotal current information because once subscribed (free of charge) you get notifications of publications by the researchers you follow.

Scopus and Web of Science have access restrictions, they are often subscription-based and thus not readily available to many researchers and institutions. This article aimed at using readily available and verifiable data. Most researchers, including up-and-coming ones, might be more familiar with Google Scholar and Research Gate due to their ease of use and accessibility.

Each database, Google Scholar, Scopus, and Web of Science, has distinct strengths that cater to specific disciplines. Table 1.1 summarizes the strengths and depth of grey matter coverage by three common academic databases.

Table 1. Strengths of Common Academic Databases

Database	Major Strength	Best for :	Coverage of Grey Literature
Google Scholar	• Excellent for interdisciplinary research due to its broad indexing of various sources, including grey literature • Free to use, making it accessible to researchers from various fields, including those in developing regions or institutions without subscriptions • Non-Traditional Literature: Useful for fields where non-peer-reviewed sources (like reports and white papers) are relevant, such as social sciences and policy studies	• Humanities and Social Sciences: Often includes many materials, including books and non-traditional publications. • Researchers in new or rapidly evolving disciplines may benefit from the diverse range of sources.	• Extensive • Ideal for researchers looking for a comprehensive view of a topic that includes diverse sources beyond traditional academic journals. • Particularly useful in fields where grey literature plays a crucial role, such as public health, social sciences, and policy studies.
Scopus	• Extensive coverage of peer-reviewed journals across various fields, with a strong focus on science, technology, and medicine. • Citation Analysis Tools: Offers robust citation tracking, h-index calculations, and advanced metrics, making it ideal for evaluating research impact. • Author Identification: Includes detailed author profiles, enabling tracking of individual researchers and their contributions across disciplines. • Provides reliable citation data and metrics for peer-reviewed articles, making it a strong choice for formal academic research but less suitable for exploring grey literature.	• Health and Life Sciences: Strong collection of biomedical literature, making it essential for researchers in medicine and health-related fields. • Engineering and Physical Sciences: Ideal for accessing high-quality articles in engineering, chemistry, and physics.	• Limited • Primarily focuses on peer-reviewed journals and does not systematically index grey literature. While it may include some conference proceedings, the overall coverage is far less comprehensive than Google Scholar.
Web of Science	• High-Quality Content: Focuses on indexing prestigious, peer-reviewed	• Natural Sciences: Highly regarded for its coverage of	• Limited

Database	Major Strength	Best for :	Coverage of Grey Literature
	journals, ensuring rigorous quality control. • Citation and Impact Analysis: Provides detailed citation metrics and impact factors, which are valuable for assessing the influence of journals and articles. • Historical Data: Offers extensive historical citation data, allowing researchers to trace the evolution of ideas and research trends over time.	high-impact journals in fields like biology, chemistry, and physics. • Social Sciences and Humanities: Strong in fields such as sociology, psychology, and history, especially for journals with a long publication history. • Best for rigorous research using high-quality, peer-reviewed sources. It also provides robust citation analysis but lacks the breadth of grey literature coverage. • The coverage of grey literature varies significantly among Google Scholar, Scopus, and Web of Science	• Similar to Scopus, Web of Science mainly focuses on indexed peer-reviewed journals and has minimal coverage of grey literature. It may include conference proceedings but does not comprehensively capture other types of grey literature

A key part of our research involved bracketing, which means being aware of and setting aside our own biases and preconceptions. This step was vital to ensure that we authentically captured participants' experiences without letting our views cloud the findings.

For analysing the data, we employed thematic analysis. This involved several stages: first, we read the transcripts multiple times individually and then held discussions on our findings to get an overall sense of the content; then, we organized the statements into themes and sub-themes. We created textural descriptions to convey what participants experienced and structural descriptions to explain how they experienced it. By synthesizing these descriptions, we aimed to capture the essence of the greening phenomenon within STEM curricula and come up proposals for the implementation strategies of a green curriculum framework.

To ensure the validity and reliability of our findings, we engaged in peer debriefing. This meant consulting with colleagues who were not directly involved in the study, which helped us validate our interpretations, reduce potential biases, and increase the flexibility of our research process. Additionally, we emphasized prolonged engagement and persistent observation, spending ample time with the literature and course outlines. This deep engagement was crucial for understanding the phenomenon and crafting relevant conclusions.

These strategies were employed to maintain ethical standards and enhance the credibility of the research findings. (Guba & Lincoln, 1982; Dibley et al., 2020).

2.2. Research Design

This study employed a Hermeneutic Phenomenological research design, which is well-suited for exploring lived experiences and understanding the complexities of social phenomena. Data was collected through a combination of literature review, and document analysis. Thematic analysis was used to identify key themes and patterns in the data. A systematic review process was followed in collecting data from published documents.

2.3. Research Questions

The research topic was broken down into smaller parts guided by research questions. Document analysis, web searches and extensive literature review was undertaken to find answers to these questions. It is

envisaged that when all the main and sub questions are answered satisfactorily then the main thrust and objectives of the study would be satisfied.

2.3.1. Main Research Question

How can Zimbabwean Higher Education Institutions (HEIs) effectively integrate sustainability principles into their STEM curricula to produce environmentally conscious graduates?

2.3.2. Sub-Research Questions

Q1: How can the current barriers to incorporating sustainability into STEM curricula in Zimbabwean HEIs be overcome?

Q2: What are the most effective pedagogical strategies for teaching sustainability concepts in STEM classrooms?

Q3: How can student engagement in sustainability initiatives be encouraged and facilitated within STEM programs?

Q4: What institutional policies and practices are necessary to support the integration of sustainability into STEM curricula?

Q5: Why are partnerships with external organizations important in promoting sustainability in HEIs?

2.4. Inclusion and Exclusion Criteria

2.4.1. Inclusion Criteria

Here are the major criteria employed for including studies in our systematic review:

- Focus on Zimbabwe: Studies must focus on Higher Education Institutions (HEIs) or TVET institutions in Zimbabwe. Studies conducted in Zimbabwe or relevant to Zimbabwean higher education institutions (HEIs) and informal economies.
- Language: Only articles published in English were considered
- Subject Matter Relevance to Sustainability: Studies must address one or more of the following aspects of sustainability in education:
    a. Climate Change Education (CCE)
    b. Disaster Risk Management (DRM)
    c. Education for Sustainable Development (ESD)
    d. Studies that explore the role of HEIs in promoting sustainable development goals (SDGs) and environmental education.
    e. Green Skills Development
    f. Green Curriculum Development
- Publication sources: Studies must be published peer-reviewed articles, conference proceedings, relevant university documents, or disaster management documents.
- Publication Date Range: Studies published between January 2019 and December 2024 (inclusive) are preferred to ensure relevance to recent developments.
- Methodology: Qualitative, quantitative, or mixed-methods studies that provide empirical data on the topics of interest. Studies utilizing interviews, surveys, or case studies relevant to sustainability education and informal sector dynamics.

- Focus on Education: Studies that assess educational strategies, curricula, and pedagogical approaches related to sustainability and environmental literacy.

2.4.2. Exclusion Criteria

Here are the criteria used for excluding some studies from our systematic review:

- Focus outside Zimbabwe: Studies focused on countries other than Zimbabwe. Studies that do not pertain to Zimbabwe or lack a connection to the country's educational practices and informal economy, Studies focused solely on developed countries without relevance to the Zimbabwean context.
- Non-English Language: Studies published in languages other than English.
- Limited relevance: Studies with minimal discussion or data on the chosen aspects of sustainability in education. Research that does not specifically address climate change, DRM, green skills, or sustainability education.
- Non-academic sources like blogs, news articles, opinion pieces, editorials, unpublished academic sources, Non-peer-reviewed articles and theoretical papers lacking empirical data or those that do not provide insights into educational practices or outcomes.
- Publication Date Range: Articles published outside the designated timeframe (before January 2019).
- Methodology: Study Design: Case reports, case series, editorials, informal online discussions
- Focus on primary or secondary education: Studies focusing on education levels below Higher Education or TVET.
- Irrelevant Focus: Studies that do not address educational outcomes or the role of institutions in promoting sustainability and resilience in the face of climate change.

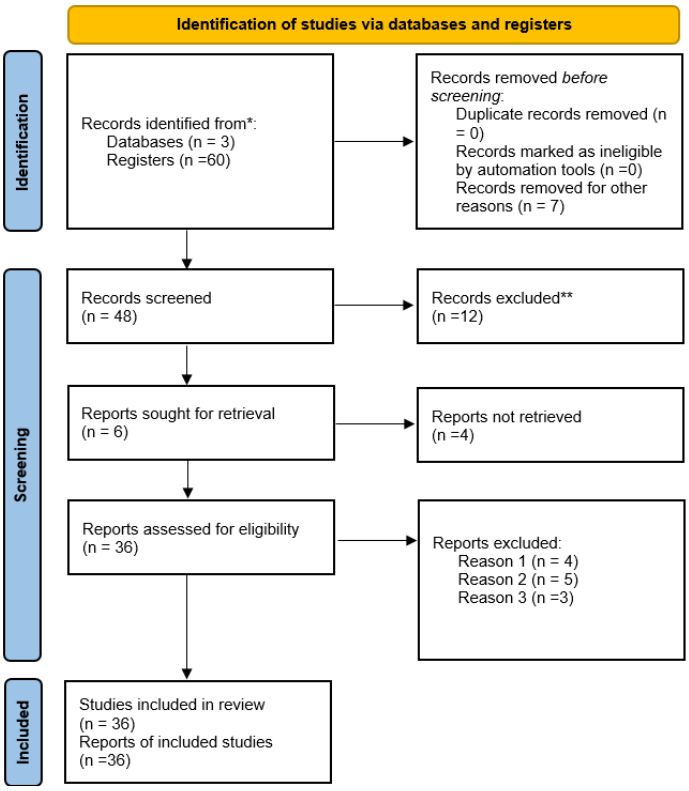

Figure 5. PRISMA Flow Diagram (Page et al., 2020)

The authors acknowledge that there are several invaluable sources on the subject matter published before 2019. However, several reasons outlined below led to their exclusion. In Zimbabwe, the greening of the curriculum was not a priority before 2019 and did not play a central role in curriculum development. Although texts and experiences from other countries could be beneficial, the researchers felt these would not directly address the local Zimbabwean context. The past five years have seen rapid advancements in knowledge and a global shift in curriculum reform, driven by advancements in technology and the digitalization of the education sector, particularly with the adoption of artificial intelligence systems and modern technology-based teaching and learning pedagogies. Studies conducted between 2019 and 2024 would more accurately capture this contemporary scenario and align the findings with modern educational settings.

One of the aims of this paper was to capture the most recent trends in development, which may not be evident in earlier publications. While these earlier contributions are highly appreciated and serve as a foundation for understanding the phenomenon being studied and in identifying the research gap that this study aims to address, reviewing a vast volume of literature could be time-consuming. It might also yield diverse findings presenting contrasting themes, complicating the ability to provide a detailed and accurate hermeneutic perspective.

By focusing on a specific timeframe, the authors aim to avoid literature saturation, allowing for a more manageable, detailed and focused review. Establishing a defined timeframe consistently ensures that the review targets a specific period, this paves way for longitudinal studies that makes it easier to analyze trends and developments over time.

2.5. Procedures

These inclusion and exclusion criteria were set in order to ensure that our study focused only on relevant and recent research data on sustainability education in Zimbabwean HEIs and TVET institutions. The criteria helped to clearly define the scope of the systematic review and ensure that only relevant high-quality studies are included, thus enhancing the reliability and validity of the review's findings. The reasons for excluding some records during filtering are presented as follows:

- Full papers not readily available online
- Lack of institutional access to some articles
- Articles with relevant information on the phenomenon but divorced from the Zimbabwean situation

2.6. Data Analysis

Thematic analysis was the most suitable method because it examines the holistic meaning of phenomena through the description of subjective perceptions (Teker & Güler, 2019).

Research findings were meticulously studied and analysed thematically. Various themes were formulated and broken down into sub-themes displayed in Table 1.2. Researchers engaged with data and care was taken to pick up points that support and explain the pivotal role played by HEIs in environmental education and to include in the design of the green course outline framework, in consideration of UNESCO guidelines.

Table 2. Thematic Analysis of Results

Main Theme	Sub-Themes	Explanation	Course Outline Development
Curriculum Integration	• Interdisciplinary Course Development • Infusion of Sustainability Themes • Use of Case Studies and Real-World Examples	This theme focuses on incorporating environmental education into the academic curriculum across various disciplines.	**Interdisciplinary Course Development**: • Creation of courses that combine multiple disciplines to address complex environmental issues. • Development of joint degree programs or minors in sustainability. **Infusion of Sustainability Themes:** • Integration of sustainability concepts into existing courses across various disciplines.

Main Theme	Sub-Themes	Explanation	Course Outline Development
			• Development of sustainability modules or case studies to be incorporated into existing courses. **Experiential Learning:** • Field trips, internships, and community service projects to provide hands-on experience. • Research projects focused on local and global environmental challenges.
Research and Innovation	• Climate Change Research • Natural Disaster Research • Sustainable Development Research • Innovative Solution Development	This theme emphasizes the role of higher education institutions in generating knowledge and developing innovative solutions to environmental challenges.	**Climate Change Research:** • Investigation of climate change impacts, mitigation strategies, and adaptation measures. • Development of climate models and forecasting tools. **Natural Disaster Research:** • Study of natural disasters, risk assessment, and disaster preparedness. • Development of early warning systems and emergency response plans. **Sustainable Development Research:** • Exploration of sustainable development goals and indicators. • Research on sustainable agriculture, renewable energy, and circular economy. **Technology and Innovation:** • Development of green technologies and sustainable innovations. • Promotion of entrepreneurship and innovation in sustainable businesses.
Community Engagement	• Awareness Raising • Training and Capacity Building • Collaborative Projects • Community Outreach	This theme highlights the importance of partnerships and collaborations between HEIs and communities to address local environmental issues.	**Community Partnerships:** • Collaboration with local organizations, NGOs, and government agencies on sustainability projects. • Joint research projects and knowledge sharing. **Community Outreach and Education:** • Public lectures, workshops, and seminars to raise awareness about environmental issues. • Development of educational materials and resources for the public. **Citizen Science:** • Engaging the public in data collection and analysis for research projects. • Empowering communities to monitor and address local environmental issues.
Sustainable Operations	• Energy Efficiency • Waste Reduction • Water Conservation • Green Infrastructure	This theme focuses on adopting sustainable practices in the day-to-day operations of HEIs, such as energy efficiency and waste reduction.	**Energy Efficiency:** • Implementing energy-efficient technologies and practices. • Promoting energy conservation behaviors among staff and students. **Waste Reduction and Recycling:** • Waste minimization strategies, such as waste audits and recycling programs. • Composting and organic waste management. **Water Conservation:** • Water-saving technologies and practices, such as water-efficient fixtures and landscaping. • Rainwater harvesting and greywater recycling. **Green Buildings and Infrastructure:**

Main Theme	Sub-Themes	Explanation	Course Outline Development
			• Sustainable building design and construction. • Green campus initiatives, such as green roofs and solar panels.
Governance and Leadership	• Sustainability Committees • Sustainability Plans • Strategic Planning Integration	This theme emphasizes the need for strong leadership and institutional commitment to drive sustainability initiatives.	**Sustainability Leadership:** • Strong leadership and commitment from top management. • Appointment of sustainability officers or committees. **Sustainability Planning and Policy:** • Development of comprehensive sustainability plans and policies. • Integration of sustainability into strategic planning. **Financial Sustainability:** • Sustainable financing models and investment in green projects. • Cost-benefit analysis of sustainability initiatives. **Monitoring and Evaluation:** • Tracking progress towards sustainability goals. • Regular assessment and reporting on sustainability performance.

3. RESULTS

The results are presented in Table 3.

Table 3. Key Research Findings

Research Question	Key Findings from Literature and Documents
Q1: How can the current barriers to incorporating sustainability into STEM curricula in Zimbabwean HEIs be overcome?	• Educational curricula, financial support, and development of teaching/learning facilities can improve the adoption of green research and education • There is a need for a more comprehensive approach that integrates sustainability into all aspects of the institution, including curriculum, research, operations, and community engagement • One study identified opportunities for upskilling informal metal fabricators through Technical and Vocational Education and Training (TVET) • Research on green skills and sustainable livelihoods in the informal economy is limited, especially in developing countries. • HEIs in Zimbabwe have the potential to play a significant role in promoting environment conservation and natural disaster risk management.
Q2: What are the most effective pedagogical strategies for teaching sustainability concepts in STEM classrooms?	• games can be used as a pedagogical tool to promote sustainable lifestyles and enhance awareness of climate change • through interactive, experiential learning methodologies • There is a lack of problem-based learning to foster critical thinking and problem-solving skills.
Q3: How can student engagement in sustainability initiatives be encouraged and facilitated within STEM programs?	• Green entrepreneurship is important for creating sustainable jobs, but its implementation is lacking. • Results indicated that ESD content remains generic, requiring a pedagogical shift and improved understanding of real-life contexts. • Findings showed Gender disparities in informal innovation spaces, with Women and girls at the receiving end.

Research Question	Key Findings from Literature and Documents
Q4: What institutional policies and practices are necessary to support the integration of sustainability into STEM curricula?	• continuous assessment of soft skills was not included in the college's formative assessment design • Results indicated that ESD content remains generic, requiring a pedagogical shift and improved understanding of real-life contexts. • Research on green skills and sustainable livelihoods in the informal economy is limited, especially in developing countries. • The Contribution of Higher Education Institutions in Zimbabwe" pointed to the lack of integrated ESD in higher education professional standards and into curriculum.
Q5: Why are partnerships with external organizations important in promoting sustainability in HEIs?	• Recent years have witnessed a spike in the emergence of TVET institutions managed by non-governmental organizations and local private colleges • Findings showed Gender disparities in informal innovation spaces, with Women facing challenges-human rights activists required • Some institutions are progressing in public engagement to support sustainable development goals while developing strategies to mitigate climate change impacts and reduce social, environmental, and economic losses. • This highlighted that educational curricula, financial support (from outside sources), and development of teaching/learning facilities can improve the adoption of green education. • However, there is a need for a more comprehensive approach that integrates sustainability into all aspects of the institution, including curriculum, research, operations, and community engagement

4. DISCUSSION

The study's findings stem from a review of over 50 peer-reviewed articles, mainly from Google Scholar, alongside conference proceedings and relevant university and disaster management documents.

It highlighted that higher education institutions (HEIs) in Zimbabwe are actively involved in climate change education and Disaster Risk Management (DRM) due to the region's vulnerability to extreme weather events. The article concluded that these institutions are progressing in public engagement to support sustainable development goals while developing strategies to mitigate climate change impacts and reduce social, environmental, and economic losses (Dzvimbo et al., 2022).

Research on green skills and sustainable livelihoods in the informal economy is limited, especially in developing countries. One study identified opportunities for upskilling informal metal fabricators through Technical and Vocational Education and Training (TVET) institutions and university innovation hubs, aiming to foster development and sustainability in the sector. A qualitative interpretive methodology was used, 40 interviews with small-scale informal metal fabricators in Harare's Magaba and Gaza home industries were conducted. Additional interviews were held with TVET educators and innovation hub lecturers, along with three months of observations to explore the issues thoroughly. Findings showed Gender disparities in informal innovation spaces, with Women facing challenges such as prejudice and abuse, which limit their participation and often restrict them to roles in customer engagement and marketing, this is a clarion call for social justice. Innovation hubs target formally educated students, overlooking informal innovators with limited education (Manyati et al., 2024).

On the African continent, 80%per cent of people, who are mostly youth, find work in the informal sector and 90% of the population is excluded from post-school qualification. Under such circumstances, the informal economy has offered spaces of inclusion and participation often better suited to accompanying young people into the world of work Metelerkamp & Monk (2023). Recent years have witnessed a spike in the emergence of TVET institutions managed by non-governmental organizations and local private colleges that are now offering innovative training courses tailor-made for the youth such as solar power installation. These studies show that TVET curricula can be significantly greened.

Findings from the study "Towards the Attainment of SDGs: The Contribution of Higher Education Institutions in Zimbabwe" pointed to the lack of integrated ESD in higher education professional standards and into curriculum. The study recommends the need to update higher education curriculum, pedagogy, and educational resources to address the twenty-first-century context of teaching and learning. The findings of this study suggest that HEIs in Zimbabwe have the potential to play a significant role in promoting environment conservation and natural disaster risk management. However, there is a need for a more comprehensive approach that integrates sustainability into all aspects of the institution, including curriculum, research, operations, and community engagement (Shava, 2020).

A particular study evaluated the integration of ESD in one teacher training college. Results indicated that ESD content remains generic, requiring a pedagogical shift and improved understanding of real-life contexts. There was a lack of problem-based learning to foster critical thinking and problem-solving skills. Additionally, continuous assessment of soft skills was not included in the college's formative assessment design (Mutseekwa et al., 2022).

A total of 145 people completed structured questionnaires, and five participated in interviews. The results showed that green entrepreneurship is important for creating sustainable jobs, but its implementation is lacking. This information is valuable for policymakers, colleges, and students. The study suggests that Technical and Vocational Education and Training (TVET) institutions in Zimbabwe should emphasize green entrepreneurship to assist graduates in becoming self-employed. The government should also boost support for eco-friendly businesses by establishing a special budget to help graduates find sustainable jobs (Mabhanda et al., 2024).

Green chemistry focuses on developing eco-friendly processes that minimize hazardous substances in chemical production. A study by Guyo et al. (2024) revealed that While Zimbabwe has made progress in areas like chemical design and renewable materials, challenges remain that hinder the adoption of green chemistry. This highlighted that educational curricula, financial support, and development of teaching/learning facilities can improve the adoption of green chemistry research and education. This notion can extend to all other education disciplines to attain a sustainable green education curriculum (Miller, 2024; Guyo et al., 2024).

How do youth acquire knowledge of sustainability concepts, responsibility, accountability, global citizenship, gender equality, and cultural diversity? This important question was explored in two case studies conducted from March 2017 to August 2018, focusing on sustainability education for students in grades 4 to 10, along with a subsequent initiative that commenced in August 2019. The findings underscored the efficacy of utilizing games as a pedagogical tool to promote sustainable lifestyles and enhance awareness of climate change through interactive, experiential learning methodologies that promote active engagement and hands-on learning experiences including Project-Based Learning (PBL) that encompass projects that address real-world sustainability issues. Service Learning: This combines community service with academic learning in practical settings that foster a sense of social responsibility. Role-Playing and Simulation: allows Students to take on roles or simulate scenarios related to global citizenship or environmental issues thus enhancing empathy and understanding. Interactive Workshops that involve hands-on activities, such as building models, conducting experiments, or engaging in discussions, promote active participation and a deeper understanding of sustainability concepts. Games and Gamification based on teaching sustainability principles to enhance engagement and motivation. These games often incorporate elements of competition and collaboration, making learning both enjoyable and impactful. Reflection and Debriefing sessions carried out after experiential activities, encourage students to think critically about their experiences, discuss what they learned, and consider how to apply this knowledge in the future. Field Studies and Outdoor Learning: Taking students outside the classroom to explore local ecosystems or community projects fosters a direct connection to the environment and enhances their understanding of ecological principles. These are some teaching and learning methods that can be employed in modern education settings for green education (Noonoo, 2019; Singer et al., 2019; Farahaty & Mahmoud, 2020).

5. CONCLUSION

The findings of this study suggest that HEIs in Zimbabwe have the potential to play a significant role in promoting environment conservation and natural disaster risk management. However, there is a

need for a more comprehensive approach that integrates sustainability into all aspects of the institution, including curriculum, research, operations, and community engagement. By implementing these strategies, HEIs can play a vital role in building a more sustainable future. They can educate the next generation of leaders, conduct ground-breaking research, and contribute to community resilience. By embracing the principles of Education 5.0 and Heritage-Based Education, HEIs can empower individual learners and communities to create a just and equitable world.

Successfully integrating ESD and CC into Zimbabwean higher education institutions' STEM curricula demands a multifaceted approach and interdisciplinary and stakeholder collaboration that can alleviate existing challenges like limited resources, inadequate educator training, and rigid examination-oriented curricula. This can also enhance the educational experience by providing expertise, resources, and real-world contexts for sustainability initiatives. By implementing active teaching and learning pedagogies like community projects, field trips, and practical activities focusing on real-world problem-solving, HEIs can effectively teach sustainability concepts and create a more engaging learning environment that encourages critical thinking and novel problem-solving.

Additionally, assessment methods should be designed to explicitly evaluate students' understanding of sustainability concepts, ensuring that their learning aligns with their engagement and comprehension. To foster institutional support, HEIs must develop policies and practices that prioritize sustainability in program development and resource allocation. Ultimately, a comprehensive strategy that blends effective teaching methods, robust learner engagement, and strong institutional support will cultivate a culture of sustainability within Zimbabwean HEIs, empowering students to address future environmental challenges.

5.1. Limitations of the Study

This study provides valuable insights into integrating sustainable practices within the curricula of HEIs and greening them. However, certain limitations that may impact the statistical power of the findings, their generalization to other settings, and the reliability of the observed effects must be acknowledged. The researchers focused mostly on achieving a nuanced hermeneutic understanding of the phenomenon under investigation, which could inform future research efforts and less on mathematical correctness.

The emphasis on academic and curriculum reforms may have constrained the scope of the study, potentially overlooking other significant factors that could influence the outcomes. For example, the political affiliations of key stakeholders and policymakers and socio-economic factors specific to individual institutions could shape their decision-making processes. Future research could benefit from a broader investigation that incorporates these additional elements for a more comprehensive understanding of the phenomenon.

A methodological limitation to consider is the dependence on secondary data sources. Any biases or inaccuracies present in the original data collection may carry over to the current study. Previous researchers or participants might have provided responses or interpretations that were more socially or academically desirable rather than completely honest and accurate. This limitation could introduce a degree of subjectivity or inaccuracy in the findings. Future studies could mitigate this issue by incorporating primary data collection methods, such as interviews and questionnaires, to enhance data triangulation.

However, the intent of this article was not to reinvent established methodologies but to leverage existing data and examine it through a fresh lens. The aim is to chart a path forward for enhancing both local and global education systems in the context of climate change and the contemporary focus on greening educational curricula.

6. RECOMMENDATIONS

In consideration of the research outcomes, the following recommendations are put forth:

6.1. Recommendations for Policy Makers

The national governing body (ZIMCHE in Zimbabwe) should make it mandatory for HEIs to explicitly include sustainability issues into their co-curricular activities across all learning disciplines, they

can design compulsory courses on environment conservation, climate chance and sustainable development. It should be borne in mind that course structures be customizable to suit the particular HEI and its immediate environment and community it serves. To ensure a holistic approach to ESD, HEIs, and curriculum developers should implement a comprehensive curricular framework that explicitly integrates environmental principles across all academic learning disciplines. This framework should be subject to ongoing evaluation and review to adapt to evolving global environmental challenges and pedagogical best practices.

Policy makers should craft a number of sustainability items as part of the criteria used in the accreditation of academic courses and also implement periodic reviews to mitigate challenges faced by institutions and assist in coming up with appropriate solutions and upgrades in conformity with local community settings and societal needs but also upholding global standards.

HEIs themselves could establish synergies with stakeholders like community based councils/committees, governmental and non-governmental organisations (NGOs) to identify knowledge and technical gaps among faculty members and students. These partnerships can mobilise funds to provide relevant green professional development and training programs, workshops, conferences, online courses, and webinars to upskill and re-skill lecturers and other workers in HEIs like technicians and administrators so that the whole institution operates in tandem. These synergies could also provide resources and incentives for faculty staff to carry out researches on sustainability and CC issues and publish their findings and thus contribute to the global knowledge base.

HEI administrators should implement policies that promote Multi-stakeholder involvement including businesses in the public and private sectors, and community organizations to promote sustainability. These partnerships can facilitate knowledge sharing, resource mobilization, and joint initiatives that promote interdisciplinary and multi sectoral researches and collaborations to facilitate a more holistic comprehension of environmental and sustainability issues. Faculty and student exchange programs could be implemented and funded by such in order to promote collaborations among local HEIs and between local HEIs and international ones to obtain a first-hand global perspective. The relationships should be symbiotic so that each party benefits from the other. HEIs can potentially bring knowledge-based solutions through research and expertise, other stakeholders can provide the much-needed resources and real-world experiences.

6.2. Recommendations for Educators

Embed sustainability themes into existing courses across disciplines, emphasizing their relevance to the subject matter, their benefit to the community, and possible contribution towards development. Teaching methods should include using real-world case studies that highlight sustainability challenges and mitigation measures relevant to the field of study and success stories to show that it is attainable.

Educators should adopt Active Learning pedagogies like Project-Based Learning where learners are actively involved in identifying, designing, implementing and evaluating projects that address local environmental issues, encouraging them to apply theoretical knowledge in practical contexts. This also promotes the acquisition of 21st century skills like collaborative Learning as they work in groups, critical thinking, communication and problem-solving skills.

Learner-centred learning pedagogies like field work and experimentation should be utilized by educators to stimulate student participation and engagement in ESD and climate change initiatives. This enhances learner ownership of the initiatives. Learners should be part of the solution and creators of knowledge not merely consumers of solutions and knowledge.

Educators should design course outlines or develop existing ones to incorporate perspectives from different learning areas. This interdisciplinary integration promotes a more holistic understanding of environmental issues thus contributing to greening the curriculum. Since one lecturer cannot be competent in all learning areas due to specialisation, team teaching with lecturers from other disciplines and inviting external experts from industry or the community to make presentations on particular topics.

Networking with Other Educators both physically and virtually promotes knowledge sharing across various platforms including social media. This allows educators to share and discuss their various experiences and gain new insights that may not be available in their particular locality.

Learner Engagement: learner-centered and active learning pedagogies like field work, project-based learning, and experimentation should be utilized by educators to stimulate student participation and engagement in ESD and climate change initiatives. This enhances learner ownership of the initiatives. Learners should be part of the solution and creators of knowledge not merely consumers of solutions and knowledge.

6.3. Recommendation for Examination Bodies

Examination bodies could advance from setting assessments that require mere memorisation of facts to those that require higher cognitive skills like critical thinking, problem solving and innovation. They should also assign reflective essays or projects that prompt students to consider their role in environment preservation and sustainable development and the impact of people's everyday choices and activities on the future. Continuous assessments could include debates and discussions on sustainability issues and environmental impact assessments.

Multi-stakeholder involvement: HEIs should collaborate with various stakeholders including businesses and community organizations to promote sustainability. These partnerships can facilitate knowledge sharing, resource mobilization, and joint initiatives. The relationships should be symbiotic so that each party benefits from the other. HEIs can potentially bring knowledge-based solutions through research and expertise, other stakeholders can provide the much-needed resources and real-world experiences.

6.4. Recommendation for Future Research

Future research should focus on longitudinal studies to assess the impact of these curricular changes on graduate outcomes. It is also recommended for future researches to focus on different time frames in order to obtain a clear focus on the progression and time evolution of the phenomenon under study.

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