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SCIENCE EDUCATION AND SUSTAINABILITY: PREPARING STUDENTS FOR A CHANGING WORLD

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Introduction

The world is undergoing rapid environmental, technological, and social transformations, making sustainability an essential, focus for education. As we look toward the future, it becomes clear that our approach to education must evolve to prepare students for a rapidly changing world. Science education plays a pivotal role in shaping the mindset, critical thinking skills, and practical solutions that students will need to address the sustainability challenges of tomorrow. Rohmah et al. (2022) emphasizes the importance of integrating real-world environmental issues into science curricula to promote sustainability awareness among student. By shoring up children's science interest and achievement today, young people may go on to become leaders and agents of change in addressing the major scientific and technological challenges of tomorrow.

Science education is not only about teaching facts and theories; it's about developing informed, engaged citizens who can think critically, make decisions based on evidence, and contribute positively to society. Brickhouse (2022) posit that science education is the preparation of citizens to engage with complex societal challenges, such as climate change and global pandemics, through informed decisions-making and critical evaluation. By incorporating sustainability into science curricula, we are not just preparing students to excel academically, but to navigate an increasingly complex world with the knowledge and skills necessary to create a more sustainable future.

Science education can promote social sustainability by teaching students to meet the needs of their immediate communities and by integrating ethno-science learning approaches that respect and incorporate indigenous knowledge systems. Esenam (2024) investigates how pre-service science teachers perceive the integration of indigenous knowledge in promoting sustainability within science education. However, fostering empathy and scientific attitudes in students can enhance their engagement with societal issues, such as public health, and encourage them to contribute positively to societal well-being.

Educating students about sustainable agricultural practices, alternative methods for conducting experiments that minimize environmental harm, and the importance of renewable energy sources can instill a sense of environmental stewardship. Encouraging activities such as tree planting and raising awareness about the environmental impacts of scientific practices can further reinforce students' commitment to environmental sustainability. Higde, (2020) examines the impact of design-based STEM activities focused on renewable energy sources. Programs like Eco-Schools demonstrate the effectiveness of involving students in environmental management practices within their schools and communities. Integrating entrepreneurship into science curricula can empower students with the skills needed to innovate and create sustainable economic opportunities. Emphasizing technical skills and problem-based learning approaches can further enhance students' ability to address real-world challenges, fostering a workforce capable of driving

economic growth and sustainability. Isa and Lawal (2023) emphasizes the need for enhancing teacher quality, curriculum review, and provision of adequate instructional resources. In Nigeria, for instance, strengthening science and entrepreneurship education has been identified as a strategy to combat unemployment and promote economic empowerment. This presentation explores the importance of science education in fostering sustainability, the role it plays in preparing students for environmental and social challenges, and strategies for integrating sustainability into the learning process.

Purpose of the Study

The overall purpose was to investigate science education and sustainability: preparing students for a changing world. Specifically, the study is determined to find:

1. Ways by which science education students are prepared for economic sustainability
2. Ways by which science education students are prepared for social sustainability
3. Ways by which science education students are prepared for environmental sustainability

Research Questions

1. In what ways can science education help students to be prepared for economic sustainability?
2. In what ways can science education helps students to be prepared for social sustainability?
3. In what ways can science education help students to be prepared for environmental sustainability?

Research Methodology

This study adopts a descriptive survey research design. The population of the study comprised all the 949 undergraduate studentS of Science Education Department Taraba State University, Jalingo. A sample size of 281 students was obtained for the study using Taro Yamane formula. The instrument for data collection is the 17 item Science Education and Sustainability Questionnaire (SESQ). The item was scaled on four-point of Strongly Agree, Agree, Disagree and Strongly Disagree. The instrument was validated by (3) experts from the Department of Science Education, Taraba State University Jalingo. Mean and standard deviation were used to answer the research questions with the decision rule pegged at a mean of 2.50.

Results

Research Question 1: Ways by which science education students are prepared for economic sustainability?

Table 1: mean rating of ways in which science education prepares students for economic sustainability

S/N	Items	SA	A	D	SD	Mean Score	Interpretation
1	Entrepreneurship should be incorporated into science curriculum	140	100	25	16	3.30	**Agreed**
2	Practical activities should be reduced in the curriculum	30	45	90	116	1.96	**Disagreed**

3	Students should be taught about scientific inventors and innovations	110	120	30	21	3.14	**Agreed**
4	Emphasis should be made on technical skills in science classes	130	100	30	21	3.21	**Agreed**
5	Problem-based learning should be emphasized at all levels of science teaching	120	110	35	16	3.19	**Agreed**
6	Science education should focus on training manpower	115	105	40	21	3.12	**Agreed**

Items 1, 3, 4, 5, and 6 have mean scores above 3.00, indicating general agreement among respondents that these are effective ways of preparing science education students for economic sustainability. Item 2 ("Practical activities should be reduced") has a mean score below 2.50, suggesting that respondents disagree with reducing practical activities — which aligns with the belief that hands-on experience is essential for real-world application and sustainability.

Research Question Two: "In what ways can science education help students to be prepared for social sustainability?

Table 2: mean rating of ways in which science education prepares students for social sustainability

S/N	Items	SA	A	D	SD	Mean Score	Interpretation
1	Science should help students learn how to meet the demands of their immediate society	135	110	25	11	3.32	**Agreed**
2	Ethno-science learning approach should be integrated in science teaching	100	120	40	21	3.06	**Agreed**
3	Empathy should be at the heart of every student learning science	120	115	30	16	3.21	**Agreed**
4	Scientific attitudes of students should be part of students' regular assessment	130	110	25	16	3.26	**Agreed**
5	Science should prioritize educating students about social issues	125	115	30	11	3.26	**Agreed**

All five items scored above a mean of 3.00, indicating that respondents agree these are meaningful ways through which science education contributes to social sustainability. There is strong support for integrating real-world social issues, empathy, local cultural knowledge (ethno-science), and scientific attitudes into science learning. The highest mean score was for Item 1, suggesting that aligning science with the needs of the local society is a top priority for promoting social sustainability.

Research Question 3:"In what ways can science education help students to be prepared for environmental sustainability?"

Table 3: mean rating of ways in which science education prepares students for environmental sustainability

S/N	Items	SA	A	D	SD	Mean Score	Interpretation
1	Sustainable agricultural practices should be taught to students	150	100	20	11	3.32	**Agreed**
2	Alternative ways of conducting harmful practicals in science should be discouraged	140	105	25	11	3.28	**Agreed**
3	Students should be encouraged to plant trees in their communities	125	115	30	11	3.21	**Agreed**
4	Environmental awareness should be instilled in students	160	95	15	11	3.38	**Agreed**
5	Students should not be exposed to environmental dangers of some scientific practices	170	90	15	6	3.45	**Agreed**
6	Students should be exposed to alternative renewable sources of energy	155	100	20	6	3.33	**Agreed**

All six items scored above a mean of 3.00, indicating that respondents generally agree with these strategies for preparing students for environmental sustainability. The highest mean score was for Item 5, which focuses on not exposing students to environmental dangers, signaling strong support for safety and environmental protection in science practices. Item 4, which emphasizes environmental awareness, also received a strong endorsement, reflecting the importance of fostering awareness among students. Items 1, 2, and 6 emphasize the teaching of sustainable agricultural practices, alternative scientific methods, and renewable energy, all of which align with preparing students to address sustainability challenge

DISCUSSIONS

The findings reveal that respondents strongly agree on several key strategies for preparing students for economic sustainability through science education. The incorporation of entrepreneurship into the science curriculum (mean score 3.30) indicates a recognition of the importance of equipping students with business acumen alongside scientific knowledge. This integration //ould foster innovation and encourage students to apply their scientific skills in entrepreneurial ventures, thus contributing to economic growth. Ewim (2023) supports this by emphasizing that embedding entrepreneurship into science education equips students with the necessary skills to innovate and contribute meaningfully to economic development. Similarly, Shamsuddin et al. (2018) argue that integrating entrepreneurial training within science and technology education promotes self-reliance and national development.

In examining the ways science education can foster social sustainability, the data indicates a strong agreement among respondents on several aspects. Notably, the highest

mean score was attributed to the idea that science should help students meet the demands of their immediate society (mean score 3.32). This reflects a growing recognition that education should not only be about knowledge acquisition but also about addressing local societal needs and challenges. Oyibe and Eluu (2014) affirm this perspective by stating that education geared towards social relevance encourages students to tackle real-world problems, thereby fostering sustainable societal development.

The respondents also expressed strong agreement on the role of science education in preparing students for environmental sustainability. The highest mean score was for the item focused on not exposing students to environmental dangers (mean score 3.45), highlighting a critical concern for safety in scientific practices. This finding reflects a commitment to ensuring that future scientists are not only knowledgeable but also responsible stewards of the environment. Supporting this, Shamsuddin et al. (2018) also note that science education must emphasize environmental responsibility to ensure that students understand and mitigate ecological risks as part of their scientific endeavors.

CONCLUSION

Overall, the findings from the three research questions collectively highlight the significant role of science education in fostering economic, social, and environmental sustainability. There is a clear consensus among respondents on the need to integrate real-world issues, hands-on experiences, and ethical considerations into science curricula. This holistic approach is essential for preparing students to meet the challenges of the future and contribute positively to society and the environment.

RECOMMENDATION

The following recommendation ensued from the findings of the study.

1. Incorporate Entrepreneurship: Add entrepreneurship training to the science curriculum to help students apply their scientific knowledge in business and innovation.
2. Address Local Needs**:** Ensure science education focuses on solving real problems in the local community to enhance social relevance and sustainability.
3. Promote Environmental Safety: Emphasize environmental responsibility in science education to prepare students to be safe and responsible stewards of the environment.

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