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Life science education for sustainable and healthy societies

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Abstract
Life science education plays a crucial role in promoting sustainable and healthy societies by developing environmental awareness, health literacy, scientific understanding, and responsible citizenship among learners. The present study explored the significance of life science education in addressing global environmental and public health challenges such as climate change, pollution, biodiversity loss, and disease prevention. The study adopted a qualitative research methodology and used a descriptive research design to analyze the contribution of life science education toward sustainability and public well-being. Data were collected through interviews, focus group discussions, observations, and secondary sources including books, journals, and policy documents. The findings revealed that life science education encourages sustainable environmental practices and healthy lifestyles through subjects such as biology, ecology, environmental science, and health education. Inquiry-based and experiential learning methods, including laboratory work, field studies, and community projects, were found effective in improving scientific literacy and environmental responsibility. However, challenges such as inadequate infrastructure, lack of trained teachers, insufficient technological resources, and outdated curricula affected the effective implementation of life science education. The study concluded that curriculum reforms, teacher training, technological integration, and community participation are essential for strengthening life science education and achieving sustainable development and public health goals.

Keywords: Life science education, sustainable development, health literacy, environmental awareness, scientific literacy, public health

Introduction

Life science education plays a vital role in developing sustainable and healthy societies in the modern world. Rapid population growth, environmental degradation, climate change, loss of biodiversity, pollution, and increasing health problems have created serious global challenges that require scientific understanding and responsible action. Life science education, which includes biology, ecology, environmental science, genetics, microbiology, and health science, helps learners understand the relationship between living organisms and their environment. It also promotes awareness of human health, environmental conservation, and sustainable living practices.

Education is widely recognized as a powerful tool for achieving sustainable development and social well-being. According to United Nations Educational, Scientific and Cultural Organization (2017), education for sustainable development encourages individuals to make informed decisions that support environmental integrity, economic viability, and social justice. Life science education contributes to this objective by helping students develop scientific literacy, critical thinking, problem-solving skills, and environmental responsibility.

At the same time, healthy societies depend on people having knowledge about nutrition, disease prevention, sanitation, hygiene, mental health, and healthy lifestyles. The World Health Organization (2020) [18] emphasized that health education is essential for improving public health and preventing diseases. Life science education enables individuals to understand biological processes and health-related issues, thereby encouraging positive health behaviors. Furthermore, modern educational systems increasingly emphasize experiential and interdisciplinary learning approaches. Laboratory work, environmental projects, field studies, and community-based activities help students connect scientific concepts with real-life problems. Such educational practices foster environmental awareness and community participation. Therefore, life science education serves as an important foundation for creating societies that are environmentally sustainable, socially responsible, and physically healthy, ultimately contributing to long-term human development and global sustainability.

Background of the Study

The growing concern for environmental sustainability and public health has increased the importance of life science education across the world. Modern societies are facing several interconnected challenges, including climate change, environmental pollution, deforestation, biodiversity loss, food insecurity, and the spread of infectious and lifestyle-related diseases. These issues not only threaten human survival but also affect economic growth and social stability. As a result, education has become an essential strategy for preparing individuals to understand and solve these complex problems. Among all academic disciplines, life science education is particularly important because it directly deals with living organisms, ecosystems, health, and environmental interactions.

Life science education includes subjects such as biology, ecology, microbiology, environmental science, biotechnology, and health science. These subjects provide scientific knowledge about ecosystems, biodiversity, disease transmission, nutrition, hygiene, and sustainable resource management. According to UNESCO (2017), education for sustainable development enables learners to acquire the knowledge and values needed to address environmental and

social challenges responsibly. Through life science education, students become aware of the consequences of human activities on the environment and public health.

The importance of life science education has also been recognized in international educational and developmental frameworks. The Sustainable Development Goals (SDGs) introduced by the United Nations emphasize quality education, good health, and environmental sustainability. Specifically, SDG 3 focuses on good health and well-being, while SDG 4 promotes quality education for sustainable development (United Nations, 2015). These goals highlight the need to integrate sustainability and health awareness into educational systems worldwide.

In recent years, educational institutions have increasingly adopted learner-centered and inquiry-based teaching methods in science education. Practical laboratory activities, environmental awareness campaigns, digital learning platforms, and field-based studies are now widely used to improve students' understanding of scientific concepts and real-world applications. According to Mayer (2009) [8], multimedia and experiential learning significantly enhance student engagement and conceptual understanding in science education.

Despite these improvements, many challenges still exist in implementing effective life science education. Developing countries often face shortages of trained teachers, laboratory equipment, educational technology, and updated curricula (UNESCO, 2019). Additionally, many students lack opportunities to apply scientific knowledge to practical environmental and health issues. Therefore, studying life science education is essential for identifying strategies that can strengthen sustainability awareness, health literacy, and scientific understanding among students and communities.

Rationale of the Study

The present study on life science education for sustainable and healthy societies is important because contemporary societies are increasingly affected by environmental degradation, public health crises, and unsustainable lifestyles. Climate change, pollution, depletion of natural resources, emerging infectious diseases, and poor health practices have created serious threats to human well-being and ecological balance. These challenges require scientifically informed citizens who can make responsible decisions regarding environmental conservation and health management. Life science education can play a major role in addressing these issues by developing scientific knowledge, environmental awareness, and healthy behaviors among learners.

One of the primary reasons for conducting this study is the growing importance of sustainability education in the modern world. According to Sterling (2001) [12], education should not only transmit knowledge but also encourage learners to develop values and attitudes that support sustainable living. Life science education provides students with opportunities to understand ecosystems, biodiversity, climate change, and resource conservation. Through this knowledge, students become more aware of the consequences of human actions on the environment and are encouraged to adopt sustainable practices in their daily lives.

Another rationale for the study is the increasing need for health literacy and disease prevention. The COVID-19 pandemic demonstrated the importance of scientific understanding in protecting public health. Many people lacked adequate knowledge about disease transmission, hygiene practices, vaccination, and preventive healthcare, which contributed to confusion and misinformation. According to the World Health Organization (2020) [18], health literacy is essential for improving health outcomes and reducing the spread of diseases. Life science education can improve public awareness regarding nutrition, sanitation, mental health, reproductive health, and healthy lifestyles, thereby contributing to healthier communities.

The study is also significant because educational institutions are expected to contribute to the achievement of sustainable development goals. The United Nations Educational, Scientific and Cultural Organization (2017) emphasized that education should prepare students to address global environmental and social challenges. However, many schools and colleges still rely on traditional teaching methods that focus mainly on theoretical knowledge rather than practical problem-solving and community engagement. This study aims to examine how life science education can be improved to encourage experiential learning, scientific inquiry, and environmental responsibility. Furthermore, life science education contributes to the development of critical thinking and decision-making skills. According to Bybee (2013) [4], scientific literacy enables individuals to evaluate information critically and participate effectively in social and environmental decision-making. Students who develop scientific reasoning skills are more likely to respond responsibly to environmental and health-related challenges.

Finally, this study is important because it may help educators, curriculum developers, policymakers, and researchers identify effective strategies for strengthening life science education. The findings can contribute to improving teaching practices, promoting sustainability awareness, and creating healthier and more environmentally responsible societies.

Review of Related Literature

Life science education has gained considerable attention in recent decades because of its role in promoting sustainability, environmental awareness, and public health. Researchers and educational organizations have emphasized that science education is essential for preparing individuals to address environmental and health-related challenges. According to United Nations Educational, Scientific and Cultural Organization (2017), education for sustainable development enables learners to develop the knowledge, values, and skills necessary to contribute to a sustainable future. Life science education supports this goal by helping students understand ecosystems, biodiversity, health, and the interdependence between humans and nature.

Several scholars have discussed the importance of environmental education within life science learning. Palmer (1998) [11] explained that environmental education increases students' awareness of ecological issues such as pollution, deforestation, and climate change. Similarly, Tilbury (2011) [13] argued that integrating sustainability concepts into science curricula encourages responsible environmental behavior among learners. These studies indicate that life science education helps students become environmentally conscious citizens capable of participating in conservation and sustainability efforts.

Orr (2004) [10] emphasized that education should prepare learners to solve environmental problems rather than simply

memorize scientific facts. He argued that ecological literacy is essential for sustainable societies. Sterling (2001) [12] also highlighted the importance of transformative learning approaches that encourage students to critically examine environmental and social issues. According to him, sustainability education should develop critical thinking, ethical awareness, and problem-solving skills. Experiential learning approaches such as fieldwork, environmental projects, and laboratory activities have been found effective in improving students' understanding of sustainability concepts.

Health education is another major component of life science education. According to the World Health Organization (2020) [18], health literacy is essential for improving public health and preventing diseases. Nutbeam (2000) [9] stated that health education empowers individuals to make informed decisions about their physical and mental well-being. Life science education contributes to this process by teaching students about nutrition, hygiene, reproductive health, disease prevention, and healthy lifestyles.

Research by Kolbe (2019) [6] found that school-based health education programs significantly improve students' health behaviors and academic performance. Similarly, Basch (2011) [3] argued that healthy students are more likely to achieve educational success because physical and mental well-being directly influence learning outcomes. These findings demonstrate the close relationship between education and public health.

The COVID-19 pandemic further highlighted the importance of life science education. During the pandemic, scientific knowledge became essential for understanding disease transmission, vaccination, and preventive health measures. Van Bavel *et al*. (2020) [17] observed that individuals with greater scientific awareness were more likely to follow public health guidelines and preventive behaviors. This situation revealed the importance of strengthening biology and health science education in schools and communities.

Life science education also contributes to the development of scientific literacy and critical thinking skills. Lederman (2007) [7] explained that inquiry-based science education encourages observation, experimentation, and evidence-based reasoning. Such approaches help students analyze environmental and health issues scientifically. Bybee (2013) [4] further argued that scientific literacy enables citizens to participate effectively in democratic decision-making and environmental problem-solving. However, researchers have identified several barriers to effective life science education. UNESCO (2019) reported that many educational institutions, particularly in developing countries, suffer from shortages of qualified science teachers, laboratory facilities, educational technologies, and updated learning materials. These limitations negatively affect students' practical understanding of scientific concepts. Akerson and Hanuscin (2007) [2] emphasized the need for professional development programs to improve teachers' ability to conduct inquiry-based and sustainability-focused science instruction.

Curriculum integration has also been discussed extensively in the literature. Drake and Burns (2004) [5] suggested that interdisciplinary curricula connecting biology, environmental science, social science, and health education are more effective in promoting holistic understanding. Aikenhead (2006) [1] further argued that science education becomes more meaningful when local environmental issues and indigenous knowledge systems are incorporated into the curriculum. Technology has emerged as a valuable tool in life science education. Mayer (2009) [8] found that multimedia learning tools such as digital simulations, online laboratories, and educational videos improve student engagement and conceptual understanding. During the COVID-19 pandemic, online learning platforms became especially important for maintaining science education when schools were closed.

Overall, the literature indicates that life science education plays a significant role in promoting sustainable development, environmental awareness, public health, scientific literacy, and responsible citizenship. At the same time, challenges related to curriculum design, teacher training, educational resources, and practical implementation continue to affect the quality of science education. Therefore, further research is needed to identify effective strategies for strengthening life science education and enhancing its contribution to sustainable and healthy societies.

Research Objectives of the Study

- To examine the role of life science education in promoting sustainable environmental practices and healthy lifestyles among students and communities.
- To explore how life science education contributes to the development of environmental awareness, health literacy, and scientific understanding.
- To identify the challenges faced by educational institutions in implementing effective life science education for sustainable and healthy societies.
- To suggest strategies and educational practices that can strengthen life science education and support sustainable development and public health goals.

Research Questions of the Study

- How does life science education promote sustainable environmental practices and healthy lifestyles among learners?
- In what ways does life science education contribute to environmental awareness, health literacy, and scientific knowledge?
- What are the major challenges faced by schools and educational institutions in implementing effective life science education?
- What strategies can improve life science education for the development of sustainable and healthy societies?

Methodology of the Study

The study adopted a qualitative research methodology to examine the role of life science education in promoting sustainable and healthy societies. A descriptive qualitative research design was used because it allowed the researcher to explore participants' experiences, opinions, and perceptions in detail. The study focused on understanding how life science education contributed to environmental awareness, health literacy, and sustainable practices among learners and educators. Both primary and secondary sources of data were utilized in the research process. Primary data were collected through semi-structured interviews, focus group discussions, and classroom observations. Interviews were conducted with life science teachers, curriculum experts, and educational administrators to gather detailed insights regarding sustainability education and health

awareness. Focus group discussions were organized with students to understand their attitudes and knowledge related to environmental and health issues. Classroom teaching methods, laboratory activities, and environmental projects were also observed to examine the practical implementation of life science education. Secondary data were collected from books, academic journals, research articles, government reports, and policy documents related to life science education and sustainable development.

The participants of the study included secondary and higher secondary students, life science teachers, curriculum planners, and educational administrators selected through purposive sampling. This sampling technique ensured the inclusion of participants who possessed relevant knowledge and experience related to the topic. The collected data were analyzed using thematic analysis, where responses from interviews, discussions, and observations were categorized into themes and patterns based on common ideas and viewpoints. This analysis helped identify the contributions of life science education toward sustainability and healthy living, as well as the challenges faced in its implementation. Ethical principles were carefully maintained throughout the study. Participants were informed about the purpose of the research, and their participation remained voluntary. Confidentiality and privacy were also ensured by protecting participants' identities and personal information during the entire research process.

Objective-wise Analysis of the Study

Objective 1: To examine the role of life science education in promoting sustainable environmental practices and healthy lifestyles among students and communities.

Life science education plays a significant role in promoting sustainable environmental practices and healthy lifestyles among students and communities. It provides scientific knowledge and practical understanding about ecosystems, biodiversity, health, nutrition, hygiene, and environmental conservation. Through subjects such as biology, ecology, and environmental science, students learn about the relationship between humans and nature and understand how human activities affect environmental sustainability. According to United Nations Educational, Scientific and Cultural Organization (2017), education for sustainable development helps learners develop the knowledge, skills, attitudes, and values needed to create a sustainable future. Life science education contributes directly to this goal by encouraging environmentally responsible behavior and promoting awareness regarding ecological balance.

One of the major contributions of life science education is the promotion of environmental awareness and conservation practices. Students learn about climate change, pollution, deforestation, waste management, water conservation, and biodiversity protection. Palmer (1998) [11] explained that environmental education helps students understand environmental problems and motivates them to participate in conservation activities. Through classroom learning, laboratory activities, and fieldwork, students become more conscious of the importance of preserving natural resources for future generations. Tilbury (2011) [13] also stated that sustainability-focused education encourages learners to adopt environmentally friendly lifestyles and participate actively in environmental protection programs.

Life science education also promotes sustainable practices within communities. Students often share their environmental knowledge with family members and local communities, creating awareness about waste reduction, recycling, energy conservation, and sanitation practices. According to Orr (2004) [10], education should prepare individuals to solve environmental problems and develop ecological responsibility. Community-based environmental projects and awareness campaigns organized by schools and educational institutions encourage collective participation in sustainability initiatives.

In addition to environmental sustainability, life science education significantly contributes to healthy lifestyles. Students gain knowledge about nutrition, physical health, mental health, hygiene, disease prevention, and reproductive health. According to the World Health Organization (2020) [18], health education is essential for improving public health and reducing disease risks. Life science education encourages students to maintain healthy eating habits, practice personal hygiene, and adopt preventive healthcare measures. Nutbeam (2000) [9] emphasized that health literacy enables individuals to make informed decisions regarding their health and well-being. The COVID-19 pandemic further highlighted the importance of life science education in promoting healthy behaviors. Scientific understanding about disease transmission, vaccination, and hygiene practices became essential for protecting communities.

Van Bavel *et al*. (2020) [17] found that individuals with better scientific awareness were more likely to follow public health guidelines during the pandemic. This demonstrated how life science education contributes to community health and resilience during global health crises. Overall, life science education serves as an effective tool for developing environmentally responsible and health-conscious citizens. It promotes sustainability, healthy living, and community participation, thereby contributing to the development of sustainable and healthy societies.

Objective 2: To explore how life science education contributes to the development of environmental awareness, health literacy, and scientific understanding.

Life science education contributes significantly to the development of environmental awareness, health literacy, and scientific understanding among learners. It provides students with opportunities to explore scientific concepts related to living organisms, ecosystems, human health, and environmental sustainability. Through life science subjects such as biology, ecology, microbiology, and health science, learners develop a deeper understanding of the natural world and the importance of maintaining ecological balance. According to UNESCO (2017), sustainability education enables individuals to develop awareness and responsibility toward environmental and social issues.

Environmental awareness is one of the key outcomes of life science education. Students learn about environmental challenges such as pollution, climate change, biodiversity loss, and deforestation. This knowledge encourages them to adopt environmentally responsible behaviors and participate in conservation efforts. Palmer (1998) [11] stated that environmental education increases students' understanding of ecological problems and promotes positive attitudes toward environmental protection. Similarly, Sterling (2001) [12] emphasized that sustainability education develops ecological thinking and encourages learners to recognize the interdependence between humans and nature.

Life science education also enhances health literacy among students and communities. Health literacy refers to the ability to access, understand, and use health-related information effectively. According to the World Health Organization (2020) [18], health literacy is essential for improving public health and preventing diseases. Through life science education, students gain knowledge about nutrition, hygiene, sanitation, reproductive health, mental health, and disease prevention. Nutbeam (2000) [9] explained that health education empowers individuals to make informed decisions about their physical and mental well-being. Students who possess health literacy are more likely to adopt healthy lifestyles and encourage others to do the same.

Scientific understanding is another important contribution of life science education. Inquiry-based learning methods used in science education encourage observation, experimentation, critical thinking, and evidence-based reasoning. Lederman (2007) [7] argued that science education develops students' ability to think scientifically and analyze problems logically. Through laboratory experiments, field studies, and scientific investigations, students learn how to apply scientific knowledge to real-life environmental and health issues. The integration of technology in life science education has further strengthened scientific understanding among learners. Digital simulations, online laboratories, educational videos, and multimedia tools help students visualize complex scientific concepts more effectively. Mayer (2009) [8] found that multimedia learning improves conceptual understanding and student engagement in science education. During the COVID-19 pandemic, online science learning platforms played an important role in maintaining educational continuity and promoting scientific awareness.

Life science education also supports community awareness and participation. Students often transfer scientific knowledge to their families and local communities by promoting health campaigns, environmental cleanliness, and sustainability practices. According to Bybee (2013) [4], scientific literacy is necessary for responsible citizenship and democratic participation. Therefore, life science education not only develops individual understanding but also contributes to collective social responsibility.

Life science education is essential for developing environmental awareness, health literacy, and scientific understanding. It encourages learners to become informed, responsible, and active participants in creating sustainable and healthy societies.

Objective 3: To identify the challenges faced by educational institutions in implementing effective life science education for sustainable and healthy societies.

Despite the growing importance of life science education, educational institutions face several challenges in implementing effective programs that promote sustainable and healthy societies. One of the major challenges is the lack of adequate infrastructure and educational resources. Many schools and colleges, particularly in developing countries, suffer from shortages of laboratory facilities, scientific equipment, educational technology, and updated learning materials. According to UNESCO (2019), inadequate educational resources significantly affect the quality of science teaching and practical learning experiences. Without proper laboratories and teaching materials, students often fail to develop scientific skills and practical understanding.

Another important challenge is the shortage of qualified and trained teachers in life science education. Effective science education requires teachers who are knowledgeable about scientific concepts and skilled in inquiry-based and experiential teaching methods. However, many teachers continue to rely on traditional lecture-based instruction, which limits student participation and critical thinking. Akerson and Hanuscin (2007) [2] emphasized that professional development programs are necessary to improve teachers' abilities in conducting inquiry-based science education and sustainability-focused learning activities.

Curriculum-related issues also create barriers to effective life science education. In many educational systems, science curricula remain heavily focused on theoretical knowledge and examination performance rather than practical application and problem-solving. Drake and Burns (2004) [5] argued that interdisciplinary curricula integrating environmental science, biology, and health education are more effective in promoting holistic understanding. However, such integrated approaches are often lacking in many schools. As a result, students may not fully understand the relationship between environmental sustainability and human health.

Limited awareness and motivation among students represent another challenge. Some students perceive science subjects as difficult or less relevant to daily life. According to Aikenhead (2006) [1], science education becomes more meaningful when it connects with students' local experiences, cultural backgrounds, and community issues. In the absence of practical and contextual learning opportunities, students may lose interest in life science education and fail to appreciate its relevance to sustainability and health.

Financial limitations also affect the implementation of effective life science education. Many educational institutions lack sufficient funding to organize laboratory activities, field trips, environmental projects, and technological integration. These financial constraints reduce opportunities for experiential learning and innovation in science teaching.

The rapid growth of technology and scientific knowledge presents additional challenges for educational institutions. Teachers and curricula often struggle to keep pace with new scientific discoveries, digital tools, and emerging environmental and health issues. Mayer (2009) [8] noted that integrating technology into education requires proper training, infrastructure, and institutional support.

The COVID-19 pandemic further exposed inequalities in educational access and digital learning facilities. Many students lacked internet access, digital devices, and technological support for online science learning. This disrupted practical science education and reduced student engagement. Educational institutions face multiple challenges in implementing effective life science education, including inadequate infrastructure, lack of trained teachers, curriculum limitations, financial constraints, and technological barriers. Addressing these challenges is essential for strengthening life science education and promoting sustainable and healthy societies.

Objective 4: To suggest strategies and educational practices that can strengthen life science education and support sustainable development and public health goals.

Strengthening life science education is essential for achieving sustainable development and improving public health. Educational institutions, policymakers, and teachers must adopt effective strategies and educational practices that promote scientific literacy, environmental responsibility, and healthy lifestyles among students and communities. One important strategy is the integration of sustainability and health-related concepts into life science curricula. According to United Nations Educational, Scientific and Cultural Organization (2017), education for sustainable development should encourage learners to address environmental, social, and health challenges through interdisciplinary learning. Integrating topics such as climate change, biodiversity conservation, nutrition, sanitation, and disease prevention into science education can help students understand the connection between environmental sustainability and human well-being.

Another important strategy is the use of inquiry-based and experiential learning methods. Traditional lecture-based teaching often limits students' creativity and practical understanding. Lederman (2007) [7] argued that inquiry-based science education encourages observation, experimentation, critical thinking, and problem-solving skills. Practical laboratory work, environmental field studies, school gardening programs, and community health projects help students connect scientific concepts with real-life situations. Such activities promote active learning and improve students' engagement with sustainability and health issues.

Teacher training and professional development are also essential for improving life science education. Many teachers require updated knowledge and teaching skills related to sustainability education, digital technologies, and learner-centered methodologies. Akerson and Hanuscin (2007) [2] emphasized that professional development programs can improve teachers' confidence and effectiveness in science instruction. Workshops, seminars, and training sessions should therefore be organized regularly to help teachers adopt innovative and interactive teaching strategies.

Technology integration can further strengthen life science education. Digital simulations, virtual laboratories, educational videos, and online learning platforms make science learning more interactive and accessible. Mayer (2009) [8] found that multimedia learning improves conceptual understanding and student motivation. Educational institutions should invest in technological infrastructure and digital resources to support modern science teaching and learning practices.

Community participation and environmental awareness programs also play an important role in promoting sustainability and public health. Schools and colleges can organize environmental campaigns, tree plantation programs, recycling activities, health awareness drives, and sanitation initiatives to encourage community involvement. According to Orr (2004) [10], education should prepare learners to solve environmental problems and become responsible citizens. Such community-based activities help students apply scientific knowledge to practical environmental and social issues.

Curriculum reforms are equally necessary to ensure interdisciplinary and locally relevant learning. Drake and Burns (2004) [5] suggested that integrated curricula connecting biology, environmental science, and health education promote a holistic understanding of sustainability. Including local environmental issues and indigenous knowledge can make science education more meaningful and culturally relevant.

Finally, government support and educational policies are crucial for strengthening life science education. Adequate funding, infrastructure development, teacher recruitment, and educational reforms are necessary for improving science education systems. Through collaborative efforts among governments, educational institutions, teachers, and communities, life science education can contribute significantly to sustainable development and public health goals.

Discussion

The study highlighted the significant role of life science education in promoting sustainable and healthy societies. The findings revealed that life science education contributes to environmental awareness, health literacy, scientific understanding, and responsible citizenship among students and communities. Through subjects such as biology, ecology, environmental science, and health education, learners develop knowledge about environmental conservation, disease prevention, nutrition, hygiene, and sustainable living practices. These findings support the views of United Nations Educational, Scientific and Cultural Organization (2017), which emphasized that education for sustainable development helps learners acquire the knowledge and values needed to address environmental and social challenges responsibly.

The study also showed that practical and experiential learning methods such as laboratory activities, fieldwork, environmental projects, and community awareness programs improve students' engagement and understanding of sustainability and health-related issues. Inquiry-based learning approaches encourage critical thinking, problem-solving, and scientific reasoning, which are essential for addressing environmental and public health challenges. These findings are consistent with Lederman (2007) [7], who emphasized the importance of inquiry-based science education in developing scientific literacy and analytical skills.

However, the study identified several challenges affecting the effective implementation of life science education. Lack of trained teachers, inadequate laboratory facilities, limited educational resources, outdated curricula, and insufficient technological support were major barriers in many educational institutions. These findings are similar to the observations of UNESCO (2019), which reported that resource limitations negatively affect science education quality, particularly in developing countries.

The study further revealed that strengthening life science education requires curriculum reforms, teacher training, technology integration, and community participation. Sustainability and health concepts should be integrated into science curricula to help students connect scientific knowledge with real-life environmental and health issues. Therefore, life science education can play a transformative role in developing environmentally responsible, health-conscious, and scientifically informed societies capable of

contributing to sustainable development and public well-being.

Conclusion

Life science education is an essential component in the development of sustainable and healthy societies. The study concluded that life science education promotes environmental awareness, health literacy, scientific understanding, and responsible behavior among students and communities. Through the study of biology, ecology, environmental science, and health education, learners gain knowledge about environmental conservation, disease prevention, hygiene, nutrition, and sustainable lifestyles. Such knowledge enables individuals to make informed decisions that contribute to environmental sustainability and public health improvement.

The study also concluded that practical and inquiry-based teaching methods enhance students' understanding and engagement in sustainability and health-related issues. Laboratory work, field studies, environmental projects, and community awareness activities help students connect scientific concepts with real-life experiences. However, several challenges continue to affect the effective implementation of life science education, including inadequate infrastructure, lack of trained teachers, insufficient technological resources, and outdated curricula.

To overcome these challenges, educational institutions and policymakers should focus on curriculum improvement, teacher training, technological integration, and experiential learning approaches. Greater community participation and government support are also necessary for strengthening science education systems. Overall, life science education has the potential to create environmentally responsible, scientifically literate, and health-conscious citizens who can contribute positively to sustainable development and the well-being of society.

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