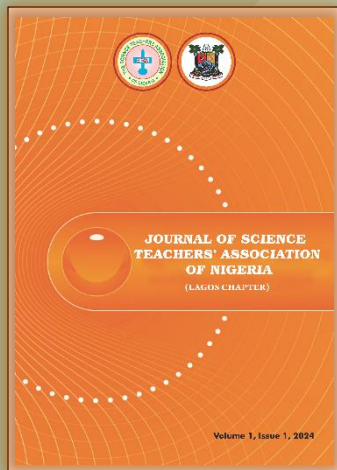




Delivery of Basic Concepts in Biology: Implications for Sustainable Development Goals

Kayode-Isola Tayo Modupe, John Bamidele Isaac & Adegorite Solomon Oyeboade

College of Science Education, Lagos State University of Education, Oto/Ijanikin, Lagos State.

ABSTRACT

In today's fast-growing population in the global world, it has become necessary than ever before, for the intersection of STEM (Science, Technology, Engineering and Mathematics) education, and the Sustainable Development Goals (SDG's) in order to provide the knowledge and skills necessary to address the challenges outlined in the sustainable development goals. Thus, this research study focuses on the delivery of basic concepts in biology and its implications for sustainable development goals. Three null hypotheses were formulated to guide the study. Descriptive survey design was used to establish the knowledge of Biology students in secondary school towards achieving sustainable development goals agenda – Vision 2030. Four hundred and thirty senior secondary Biology students (SSS 2 and 3) were involved in the study. These respondents were randomly selected from four senior secondary schools in Lagos State Education District 1. A self-designed questionnaire structured on four point Likert's scale was the instrument used for the study. The instrument was validated by two experts in Biology education and the reliability index determined using Chronbach alpha yielded a coefficient of 0.74. Pearson chi-square statistics was employed to analysed the data collected at 0.05 significant alpha level. The study findings from hypotheses one and three reveal that there is no significant relationship between secondary students' biology knowledge of ecosystem and skill acquisition; and students' knowledge of ecosystem and environmental sustainability. However, hypothesis two shows significant relationship between students' practical knowledge in secondary school biology and bio-agricultural concepts. Hence, it can be concluded that practical knowledge is necessary for acquisition of relevant skills for STEM education and sustainable development goals. Some recommendations were made such as encouraging sufficient hand – on learning in secondary school teaching, biology laboratory should be well equipped for meaningful practical to be realized, biology curriculum should be rich enough to accommodate topics relating to bio-agriculture, ecosystem and environmental issues.

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Introduction

Science Technology, Engineering and Mathematics (STEM) Education have been proven to be an indispensable factor in solving increasingly complex and interconnected challenges confronting the world. A learning and development method that incorporates Science, Technology, Engineering, and Mathematics is known as STEM education. Students gain important abilities like creativity and problem-solving through STEM. According to Aditi (2023), competencies of STEM Education are composed of three core dimensions: learning and innovation skills, information media and technology skills, and life and career skills, which emphasizes creativity and innovation, critical thinking and problem solving, communication and cooperation (ethical awareness). These are all key skills for finding solutions to complex and interconnected challenges, such as ensuring food security, reducing greenhouse gas emission, wise use of natural resources and its sustainability. Hassan, (2024) emphasised that STEM education encompasses more than just teaching mathematics, science, and technology. It is a means of cultivating values, attitudes, and abilities that can lessen the difficulties associated with achieving the global goals of sustainable development.

The need for sustainable development in education has grown because of its ability to solve societal issues like food and social insecurity, environmental deterioration, and economic instability. Sustainable development has garnered significant attention on a local and global scale, and this trend is reflected in various parts of daily life. Sustainability as a concept literally means the ability of a system to continue itself perpetually or for a long time, (Encarta Dictionary, 2009). Sustainability is viewed by the Hariram et al., (2023) as a systematic notion that pertains to the continuation of the non-human

environment and the institutional, social, economic, and environmental facets of human civilization.

Thus, the Sustainable Development Goals (SDGs) are a set of seventeen goals that the United Nations General Assembly adopted in 2015. These goals are essential to enabling the necessary change, which is embodied in addressing the challenges facing humanity in the area of development, to ensure that all inhabitants (both present and future) enjoy a sustainable life that is marked by peace, prosperity, and justice (Maryanti et al., 2022; UNESCO, 2014). It also illustrates the environmental limitations on the use of natural resources and their upper bounds. The objectives cover a wide variety of social demands, including employment creation, social protection, health care, and education. They care about the environment and the climate as well. According to the UN General Assembly's report, high-quality education can help the world's learners of all ages develop the specialized skills they need to succeed if it can address and nurture these needs.

The STEM Education approach is one of the modern teaching approaches in the world generally that can help learners acquire the knowledge, skills and attitude that are essential for achieving the Sustainable Development Goals (Yue & Li, 2024). Therefore, there is need to recontextualize STEM education for sustainable development goals. Recontextualization is a process of transformation of the meaning attributed to firm offering [technologies, work practices, products etc.], as they are uprooted from one context and transplanted into another (Alaric, 2024). Hence, recontextualization tries to re-interpret a certain concept in a contemporary cultural context. Oddo (2013) defined recontextualization as the process of removing knowledge from its native context and incorporating it into student textbooks, instructor lesson plans, and school curricula. Students are expected to grasp scientific concepts in STEM education methods, but they are not given



access to the cultures and practices that have created and applied this knowledge. As a result, teachers should let students develop scientific notions in light of the surrounding circumstances. Students should also be able to recontextualize ideas and apply their knowledge of one context to another. In view of this, what the school teaching and learning process needs, may not necessarily be new curriculum, but to look into the way and manner the context of the curriculum can be interpreted to the learner in a renewed manner which involves act of doing- hands-on, to creating skill acquisition and critical thinking, thereby employing STEM education methods for sustainable development goals.

Biology as a branch of science education in STEM plays a crucial role in environmental conservation and sustainability as it provides the scientific understanding needed to protect and preserve our planets biodiversity and natural resources (Adom, 2019; McGrath, 1999). The biology of the twenty-first century depends on combining information from other fields to gain a greater comprehension of the biological system. The development of biologically based solutions to societal issues is made possible by this better understanding, which also provides feedback to enhance the various scientific fields that may aid in the advancement of society. Yudha and Ali (2019) in their support of interdisciplinary knowledge, said, 21st century biology is necessarily inter-disciplinary system oriented and integrative Biology education and science could support sustainable global goals specially to end hunger, pollution and promote skill acquisition for creativity and self-independence.

Teaching of biology in senior secondary school is of utmost importance for variety of reasons, as it is a fundamental branch of science that provides wealth of knowledge about the living world around us. Again, as it provides understanding of life processes, appreciating biodiversity, understanding human

health, environmental awareness, career opportunities, more so, learning about biology can be personally fulfilling and inspire a lifelong interest in science that enhances essential knowledge and skills that are relevant to live the world around us.

Therefore, the application of STEM core dimension to learning is of high importance in the teaching and learning biology in secondary school for sustainable development goals, hence, this research focuses on the Delivery of Basic Concepts of Biology: Implications for Sustainable Development Goals.

A lot of efforts have been made to improve the teaching and learning of concepts in biology such as introduction of relevant concepts and bringing new innovations into the curriculum (Janssen & Waarlo, 2010; Udeani et al., 2016). The curriculum has also been designed to meet up with STEM so as to realize the sustainable development goals (Wibowo & Sadikin, 2019). However the extent to how these have been achieved is yet to be determined. The contributions and participation of secondary school students and biology graduates in issues relating to biodiversity, ecosystem, conservation, food production and the likes are yet to be proved in the society. Though often time's teachers' competence, resources available for teaching and lack of relevant science equipment amidst others have been held responsible for non-realizations of desired goals in education. However, the knowledge acquisition in the biology curriculum is only examined in a classroom test and internal or external examinations but its realization in the society is still questionable. The present study is necessary to determine the extent at which the biology curriculum have meet up with sustainable development and vision 2030 development goals in the society.

Purpose of the Study

The purpose of the study is to find out the extent of delivery of basic concepts in biology and its



implications for quality environment for Sustainable Development Goals. The specific objectives of the study are to find out:

1. If practical works in secondary schools, biology subjects will enable students to acquire skills and experience needed for Sustainable Development Goals.
2. If bio-agricultural knowledge of secondary school students will enable students to participate in food production for Sustainable Development Goals agenda.
3. If the knowledge of ecosystem in secondary school will provide information necessary to make the environment healthy for future generations.

Null Hypotheses

The following null hypotheses were developed.

- HO₁:** There is no significant relationship between practical knowledge of students in secondary schools biology and skills acquisition for Sustainable Development Goals.
- HO₂:** There is no significant relationship between bio-agricultural knowledge of students in secondary schools biology and food production for Sustainable Development Goals.
- HO₃:** There is no significant relationship between students' knowledge of ecosystem in secondary schools biology and environmental sustainable development goals.

Methodology

This study employed a descriptive survey design. The survey method allows generalization to be made from the responses of the sample population and inferences can be made about the total population (Babbies, 2001). The target population for this study

was all biology students in public senior secondary schools in Education District I, Lagos State, Nigeria. Four hundred and thirty biology students in SS2 and SS3 were randomly selected from eight randomly selected senior secondary schools in the Education District. The choice of SS 2 and SS 3 was done using a purposeful sampling technique, with the criteria being that at least 70% to 80% of their syllabus has been covered by them.

A self-developed questionnaire was used to collect data from respondents. The content of the questionnaire was developed based on the following: practical knowledge of secondary school biology students, bio-agricultural knowledge of secondary school students, and ecosystem knowledge of secondary school biology students. The questionnaire consisted of three sections; A, B and C. Section A elicited respondents' personal data (school, class and age), section B contained 10 items on knowledge of biology, divided into three areas as; practical knowledge, bio-agricultural knowledge and ecosystem knowledge, while section C contained 10 statement items that dwells on the basic biology knowledge that could enable students in secondary schools participate in achieving the sustainable development goals agenda. This was rated on 4-Liker Scale of Strongly Agree [SA], Agree [A], Disagree [D] and Strongly Disagreed [SD]. The questionnaire was validated by two experienced biology teachers and was subjected to Cronbach Alpha reliability coefficient method to yield a reliability index of 0.74. The questionnaire was administered by the researchers to the participants in the sample secondary schools personally. The researchers explained the method of responding to the students and guided them appropriately. The completely filled questionnaires were collected immediately. The data collected were coded as Strongly Agree [4], Agree [3], Disagree [2] and Strongly Disagreed [1] for analysis. The inferential analysis of Pearson Chi-



square at 0.05 significance level using SPSS 23.0 was employed to test the null hypotheses in the study.

HO₁: There is no significant relationship between practical knowledge of students in secondary school biology and skills acquisition for Sustainable Development Goals.

Results

Table 1: Relationship between students' practical knowledge in secondary school and skill acquisition for sustainable development goals

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.050	4	.399
Likelihood Ratio	4.195	4	.380
Linear-by-Linear Association	3.493	1	.062
N of Valid Cases	430		

Table 1 shows the results of relationship between biology practical knowledge of students in secondary schools and skill acquisition for sustainable development goal. The results indicate a non-significant relationship between students' practical knowledge and skill acquisition in secondary school biology for sustainable development goals [$X^2=4.05$, $df=4$; $p>.05$]. This implies that, the quality of practical carried out in secondary school is not enough to enable the students to acquire skills for sustainable development goals. Therefore, the

hypothesis that states that there is no significant relationship between practical knowledge in secondary school and skill acquisition for sustainable development is not rejected.

HO₂: There is no significant relationship between bio-agricultural knowledge of students in secondary schools biology and food production for Sustainable Development Goals.

Table 2: Relationship between bio-agricultural knowledge of students in secondary schools and food production for sustainable development goals

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.405	4	.015
Likelihood Ratio	13.681	4	.008
Linear-by-Linear Association	3.940	1	.047
N of Valid Cases	430		

The result in Table 2 shows relationship between bio-agricultural knowledge in secondary school and food production for sustainable development goals. The result reveals a significant relationship between

students' bio-agricultural knowledge in secondary school and food production for sustainable development goals [$X^2=12.41$, $df=4$; $p<.05$]. This indicates that, the secondary school students' knowledge in bio-agriculture is adequate for food



production for sustainable development goals. Therefore, the null hypothesis which states that there is no significant relationship between bio-agricultural knowledge of students in secondary school and sustainable development goals is rejected.

HO₃: There is no significant relationship between students' knowledge of ecosystem in secondary school biology and environmental awareness for sustainable development goals.

Table 3: Relationship between students' knowledge of Ecosystem in secondary school and environmental awareness for sustainable development goals

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.971	6	.063
Likelihood Ratio	11.533	6	.073
Linear-by-Linear Association	4.294	1	.038
N of Valid Cases	430		

The results in Table 3 shows no significant relationship between the knowledge of ecosystem of students in secondary school biology and environmental awareness for sustainable development goals [$X^2=11.97$, $df=6$; $p>.05$]. This implies that secondary school students' knowledge of ecosystem is not adequate for addressing environmental challenges in order to promote sustainability. Hence, the hypothesis which states that there is no significant relationship between students' knowledge of ecosystem in secondary school biology and environmental awareness for sustainable development goals is not rejected.

Discussion of Findings

The finding from hypothesis one indicates a non-significant relationship between students' practical knowledge and skill acquisition in secondary school biology for sustainable development goals. The study finds no correlation between students' practical biology knowledge in secondary school and their ability to acquire new skills. This suggests that the link was poor, suggesting that secondary school biology students are not sufficiently involved in practical activities or prepared in terms of skill acquisition for sustainable development goals.

This result is consistent with Amaefuna (2013), who found that students who were taught process skills methods outperformed their peers taught with lecture method in biology. The finding also is in agreement with the study of Ikpuri (2023), Njoku and Mgbomo (2021), and Ezechi (2018) who found that practical activities and field trips are essentials in the acquisition of relevant hands-on skills needed for sustainable goals in the society.

The study also reveals from hypothesis two, a significant relationship between students' bio-agricultural knowledge in secondary school biology and food production for sustainable development goals. The result implies that food production for sustainable development objectives and secondary school students' bio-agricultural knowledge are positively correlated. This demonstrated the need for secondary school biology students to have a solid understanding of biology and to apply that knowledge to the production of food for sustainable development. Naila et al. (2021) believed that a biology curriculum should cover current biological areas and emphasize how studying biology can be applied to real-world issues. These include how discoveries and innovations are used in the environment, industry, health, and agriculture. This



is also consistent with the research conducted by Sallau et al. (2018), who found that biology plays a major role in bio-agriculture and related fields. In the word of Umar (2023) and Aina (2013) who opined that individual need appropriate knowledge and skills in the pharmaceutical, medical, agricultural, industrial and scientific aspects of the economy. For a nation to advance they must have well trained and capable persons in handling so many sensitive areas connected to health, food production, manufacturing of finished products coupled with general satisfaction with little or no importation of goods from other nations of the world. These aspects have not been achieved in Nigeria because food and other finished products are still imported.

While Dutta (2015) emphasized that educational system must meet the demands for recruitment and training by which the whole range of a complex and varied occupational hierarchy depends. The problem turns out to be not only a question of the provision of schools and universities, and the allocation of resources in money and materials, but also a question of the different scientific attitudes, assumption and experimentation with regards to biological courses in schools which are associated with the different occupational status in our society.

The finding from hypothesis three shows no statistically significant correlation between secondary school biology students' understanding of ecosystems and the objectives of environmental sustainable development. This suggests that secondary school students do not have a sufficient understanding of the ecosystem, which will support the objectives of sustainable development. It demonstrates how shoddy and insufficiently the curriculum delivers ecosystem content. This finding is consistent with Belen (2020), and Buldur and Ömeroğlu (2018) who discovered a weak correlation between behaviour, attitude, and attainment of

environmental sustainability objectives. Consequently, this finding aligns with Emine-Aydin et al. (2022) who noted similar trends. Additionally, Deman (2013) discovered a favorable medium-level correlation between students' learning levels on ecosystem themes and their awareness of the environment.

Conclusion

It could be concluded from the study that practical knowledge is necessary for acquisition of relevant skills for STEM education and sustainable development goals. This is the reason why it was revealed from the study lack of correlation between practical knowledge of students in secondary school biology and skills acquisition. Many previous studies have concluded inadequacies in laboratory facilities, well equipped laboratory and material needed for meaningful practical to take place. This shows that biology curriculum in secondary school is not adequately delivered especially in the area of hands-on skills required for sustainable development goals.

Knowledge of bio-agriculture is required for individual especially secondary school students to participate effectively in farming and food production for sustainable development goals. Nigeria is an agrarian society hence all hands must be on deck to improve food production. The curriculum must be rich and relevant material must be made available to achieve the goals of UNESCO vision 2030 agenda. Finally, our environment is our life, it is compulsory that issues relating to ecosystem and management of the environment forms the core biology curriculum. This will help the individual to be aware of their roles and duties in sustaining their environment.

Recommendations

Based on the findings, this study recommends that:



1. Educators and administrators must encourage sufficient hands-on learning opportunities in biology for senior secondary students in order to help them develop the practical skills of creativity, critical thinking, and curiosity that are necessary for understanding and utilizing specific scientific concepts and materials.
2. The biology laboratory should be furnished with the tools and resources required to encourage practical work in secondary education and the period for practical works in biology should always be observed for the purpose and not to be seen as play time.
3. Students should be engaged in school farming as hands-on to further promote and inculcate farming skills relevant for food production in them.
4. Students should be engaged in school project relating to ecosystem and environmental management such as bush clearing, digging channels for erosion, different methods of disposing school refuse, reading environmental temperature and rainfall etc.

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