INVESTIGATE THE SUSTAINABILITY PRINCIPLES EMBEDDED IN THE SECONDARY SCHOOL BIOLOGY CURRICULUM

Naila Zarar^{1*}, Muqaddas Butt², Aatika Aziz³

^{1*,3}Ph.D. Scholar, Division of Education, University of Education, Lahore, Pakistan; ²Assistant Professor, Division of Education, University of Education, Lahore, Pakistan.

Email: ^{1*}naila.zarar10@gmail.com, ²muqaddas.butt@ue.edu.pk, ³aatika.aziz03@gmail.com

Article History: Received on 15th June 2021, Revised on 29th June 2021, Published on 30th June 2021

Abstract

Purpose of the study: The study aimed to investigate the sustainability principles embedded in the secondary school Biology curriculum in Lahore. Secondly, it helps explain the theoretical frames which underpinned the embedding of sustainability principles into the secondary school Biology curriculum.

Methodology: The qualitative research method was employed to collect the data to answer the posed questions. Analysis of the Biology curriculum document was opted to analyze the sustainability principles embedded in the secondary school Biology curriculum.

Main Findings: The result of the study revealed that the inclusion of sustainability in the curriculum of secondary school Biology made it more organized, coordinated, and formal. However, there is a need to emphasize the memorization and retention of irrelevant material, themes, or detail. In the limited portions of the Biology curriculum, the social and economic aspects omit and practical, experimentation or application of the written content work ignored in the curriculum.

Applications of this study: The study will shed new light on the progressive and applicable implementation of sustainability principles. The systematic and coordinated inclusion of the sustainability principle in the biology curriculum will help students cope with the needs and demands of a future society.

Novelty/Originality of this study: There was a considerable amount of work on the science curriculum and the alignment of the textbooks. However, it is improper in the Biology curriculum. In this project, scientists analyze individually or simultaneously the principles of sustainability in the biology curriculum. This study will also help the curriculum developers to make a curriculum that must reflect our social, Islamic, environmental, and economic needs.

Keywords: Sustainability, Sustainability Principles, Secondary School, Biology, Curriculum.

INTRODUCTION

The education for sustainable development (ESD) concept is multiplying progressively at every level of the educational system. The UN International Environmental Education Program (1975–1995) first thought of sustainability in a secondary and higher level of education, and the UN is now consistent with all nations to address ESD by proclaiming 2005 to 2014 the decade for ESD by reviewing the activity portion of ARIES (Australian Research Institute in Education for Sustainability (Tilbury, Keogh, Leighton, & Kent, 2005)). According to proponents of the ESD curriculum, it is the responsibility of states to train leaders to implement most of the environmental policies to prevent ecological collapse through the curriculum or study plans. (Moore 2005).

Even though ESD is a broadly used term, there remains a gigantic discussion related to its definition. (Sauvé, 1996). To keep up the degree of sustainability, we need to consider the sustainability standards or principles in the educational field. The sustainability standards are economy, socio-cultural and environmental, and politics. These principles are the fundamental support and elements for sustainability to set up a solid domain concerning the educational environment. The engineers of the UNESCO assertion conceptualized the mainstays of sustainability as containing three reliant frameworks: economic, socio-cultural, and environmental as measurement. (UNESCO, 2005). There is no pre-determined and transparent way, as the very reason for sustainability is one of a co-transformative learning process instead of having a limited destination and goal. (Huckle, 2005). Supportability standards can be a drive for development and a vehicle in support of change. Changes in curriculum, teaching method, and program content have gotten a lot of consideration from the sustainability principles (Holdsworth, Wyborn, Bekessy, & Thomas, 2008).

Nowadays, the most commonly used model of SD consists of three principles. These sustainability principles ensure and appreciate the concept of sustainability in environmental, social, and economic areas.

The three-column sustainability model (Figure 1) is broadly acknowledged worldwide, yet it has got additional appreciation regarding whether it speaks to a palatable establishment for managing educational issues concerning sustainability. Wheeler (2000) illustrated a few such reactions, focusing on the way that being compelled to at the same time think about three principles, yet very free spaces make it progressively hard to gain proficiency with the correct method of acting. Learning and knowledge about human-made and natural environments utilizing a coordinated perspective on their political, social, economic, and ecological (and potentially cultural) measurements and dimensions, including inclusion at the national and international encompass global level.

Figure 1: Sustainability principles

Source: [Pawłowski, A. \(2008\)](#). How many dimensions does sustainable development have?

ESD gives guidance for educational exploration, including teaching in the classroom with improvement and fostering teacher education ([UNESCO, 2005](#)), as for education and in science education specifically. It has got one of the essential curriculum directions describing science education ([Eilks, Nielsen, & Hofstein, 2014](#)). It likewise requests all the more societal situated science education ([Hofstein, A., Eilks, & Bybee, 2011](#); [Holbrook & Rannikmae, 2007](#)).

The curriculum development is a combined effort of all agencies and stakeholders (e.g., curriculum developers, curriculum specialists, educational managers, students, teachers, and parents). The curriculum indicates such achievable learning outcomes that are after classroom instruction. It directs the educators, curriculum developers, textbook developers, and instructional material developers along with examiners. Though, directions given via curriculum are generally not followed ([Goodson, 2010](#)). Issues that have obliged the introduction and concept of sustainable development at a higher level of education incorporate progressing perplexity over phrasing and discussion relating to whether sustainable development is a legitimate element of the educational program (i.e. curriculum). The curriculum introduced by PCTB is theoretical and advances basic reasoning. The new methodology uses hands-on encounters and the usage of assets accessible in the student's environment.

The adaptation of new teaching methodologies is combined with various appraisal and evaluation procedures to monitor and improve students' academic achievement. It incorporates the ideas presented at lower levels than the curriculum expresses and belongs to areas of Biology concerned with associations of research of Biology to genuine issues covering the utilization of revelations/advancements in daily life routine - in conditions, industry, medication, the environment, the environment, and agriculture. It covers almost all the ideas related from cells to living beings to whole biological systems and clarifies the relationship of Biology with different subject matters and areas. This curriculum will prepare students for entering tertiary courses, job-related courses, or the workforce in various life science fields in the twenty-first century.

The role of science for sustainable development in present-day social orders proposes the focal job of science instruction in ESD ([Bradley, 2005](#)). The significant function of industrial developing productions grounded in science lends science instruction focal importance regarding ESD. Although there is the risk of environmental change, the above pathways for comparing activities, reactions to our own lives due to the creation and utilization of energy-related products, and the range of choices for maintaining personal vitality allow us to discover new ways to live which are more sustainable. Developments in science are interlinked with biological, economic, and societal effects ([Feierabend, Jokmin, & Eilks, 2011](#)). The resulting decisions about these issues are considerably progressively significant. In this manner, science education shows extraordinary potential for enhancing the degree of general instructions and its related skills amongst students in the sagacity of participatory learning ([Eilks, 2002](#)). This occurs due to society and culture continually progression and development, which science can reference as an example of when a multidimensional technique is applied.

The main research objectives of the study were:

- To analyze the theoretical frames underpinned the embedding of sustainability principles into the secondary school biology curriculum.
- To explore the sustainability principles embedded in the secondary school biology curriculum.

LITERATURE REVIEW

Secondary education is opted to rehearse initiative achievement for practical enhancement. Various informational foundations are starting now, setting off the crisis of manageability on an overall scale. All through the primary part of

the United Nations Decade of Education for Sustainable Development (2005), unique approaches have been associated with making sensible enhancement, a transversal turn inside the field of cutting edge instruction ([DESD, 2005](#)). Generally, there have been many practical endeavors to consolidate manageability into training and learning ([Barth, Michelsen, and Sanusi, 2011](#)).

The idea of Sustainable development (SD) tries to consolidate ecological concerns with economic and social development. The concept started to become widely accepted in the 1980s when the Our Common Future study got released under the report title of the 1987 Brundtland report. Up to that point, natural security and environmental protection had been the central logical point, emerging from striking ecological issues. With the idea of SD, it was highlighted that environmental matters ought to be managed in connection to social and economic problems. SD is, in present society, an overall objective of adjusting between the prosperity of beings and improved existences of individuals all around in reality while simultaneously safeguarding standard assets and environments (ecosystem) ([Atkinson, Dietz, & Neumayer, 2007](#)).

The United Nations raised sustainable development on the worldwide plan to improve activities for a sustainable, feasible future. UNESCO has illustrated various sub-subjects to the environmental, economic, and social dimensions of SD: (1) environmental angles: natural resources (water, agriculture, energy, and biodiversity), climatic or environmental change, rural and urban development, supportable urbanization, disaster management, and; and (2) socio-cultural angles: rights of human, harmony, and security of human, sexual orientation balance, diversity in socio-cultural and understanding in intercultural and understanding among cultures (multicultural concepts, health-related concepts, HIV/AIDS) and administrative system of the country -governance; and (3) economic angles: poverty reduction, the responsibility of corporate and market economy and accountability ([UNESCO, 2009](#)) (pp. 18–21).

Most cases of deteriorating conditions of the environment occurred due to human conduct. Drivers of sustainability issues are infrequently the aftereffect of cruel intent, but instead the outcomes of the ways of life of billions of people. Sustainable development is "a goal that must be achievable by shifting the behaviour of humans" ([Schultz, 2011](#)). The activity of that behavior can work at various degrees of the society, from the lifestyle of a person to political and business-related leadership decisions. And thus, different aspects of personal power result in sustainable development. Besides, practices for sustainable development are controlled by cultural, structural, environmental, and economic barriers as appeared ([Isenhour, 2010](#)).

The idea of a sustainable curriculum is a composite thought, bringing together substance in environmental, economic, and social issues, just as psychological perspectives related to behaviour, knowledge, and attitudes identify such problems.

The idea of a sustainable curriculum was to develop it in close connection to the UNESCO sub-topics outlined. To achieve a sustainable future, fundamental elements for change incorporate a superior understanding increasingly uplift the attitude positive and following the practices and standards of sustainable development. The answer is followed by a question to be addressed how to achieve this determined goal? How might we change the way of our future? In the last decade, one of the most common responses from this inquiry is the education and training of teachers ([Pauw et al., 2015](#)).

The concept of quality in education depends on the reason that educational aims are met and purposes satisfied. In the Foreword to the 2005 Global Monitoring Report for EFA, UNESCO Director-General Koïchiro Matsuura composed, 'Quality must be found considering social orders that define the motivation behind education' ([UNESCO, 2004](#)). For a considerable length of time, the purpose behind education in the United States (US) and other industrialized nations was to teach a workforce. At that point, the idea for education moved inside the economic domain to universal economic competitiveness. While economic prosperity remains a significant result of schooling for nations, countries, networks, families, and people, the center is, by all accounts, floating away from the economic intensity and towards global citizenship, social equity, and sustainability.

For conceptualization, curriculum and teacher pedagogy require changes, but the question is what kind of changes to the educational plans and the teaching methods are needed. It is useful to consider conceptualizations. ([Gough & Scott, 2003](#); [Vare & Scott, 2007](#)). They were distinguished from three sorts of approaches by Scott and Gough in 2003. The first is that the issues looked at by humankind are fundamentally environmental, and the solution is base on a belief that communication and accomplishment of this scientific information are sufficient to induce the required changes. The second is environmental concerns, which are symptomatic of a broader social and political unease. The two methodologies necessitate social change, respond to the domain of the current ideal paradigm of information and thinking, and prioritize reports on 'external or outside others,' such as perceived specialists ([Vare & Scott, 2007](#)). Conversely, the third approach expects our present knowledge and perception to be inadequate. The way toward sustainability is not consistent hence, requiring our learning to be more future-oriented and open-ended.

Progressively, learning for sustainability is not just an add-on or cross-educational planning theme, i.e. curriculum, is perceived. But it requires a critical move in the current curriculum practice. Learning for sustainability is not exclusively about the assimilation of new materials into the curriculum; it is additionally about challenging and testing teaching and learning. Another essential feature is that the curriculum should be multidisciplinary and all-inclusive in recognition that

one must comprehend and apply the principles to solve the intricate problems of daily life. The rise of interdisciplinary thinking was obstructed by independent academic disciplines, especially within the organization and association of teaching and learning (Nolet, 2009).

The economic direction of schooling is determined by how the current curriculum is constructed, with control and competition taking precedence (BAKER, 2008). Similarly, imposing such a curriculum reflects mechanistic reasoning and the assumption that learning goals can be pre-determined and that learning and teaching can be directed in a predictable linear pattern. This sort of reasoning has been the domineering perspective in education for more than a long time since the Industrial Revolution, and opportunity has arrived for another era in education (S Sterling, 2003) (Gadotti, 2010). The participatory curriculum has the objective of global endurance and consensus through maturity of teachers teaching strategies and students with the process and content of learning may prompt increasingly equitable and sustainable ways of living (BAKER, 2008).

Biology is the most frequently necessary topic for entry into numerous professional degrees, such as medical, nursing, pharmacy, nursing, and biotechnology, to highlight a few simple, selected categories. Biology assists students in understanding their surroundings and expects pupils to acquire awareness, a good attitude, a scientific temper, a sense of value, and the ability to communicate effectively. NFC's primary focus is on the secondary school biology curriculum, making scientific concepts in the reach of learners, and including and delivering content elements (ideas, facts, theories, attributes, principles, formulas, and diagrams) in a simplified and meaningful manner during classroom instruction. When it comes to biology textbooks, they serve as a link between teachers and learners at the secondary level (IX and X grades). The Biology textbook, regarded as a mirror image of the curriculum and syllabus for the secondary school Biology subject, is intended to be accurate. American science teachers, particularly biology subject teachers, rely entirely on books for instruction, with approximately 90% of them doing so in the classroom (Abimbola & Baba, 1996).

The Biology Curriculum comprises ideas, facts, concepts, theories, laws, signs, principles, diagrams, equations, hierarchy, process, and characteristics by following the sustainability principles. Biology Teachers suggested that there may be a chance to face misconceptions in them because they failed to build a relationship and perceived the content and its elements scientifically, this misconception is transformed in students as well.

METHODOLOGY

The study aimed to analyze the theoretical framework that underpins the embedding of sustainability principles into the secondary school Biology curriculum and investigate the sustainability principles found in the secondary school Biology curriculum and textbooks. An exploratory approach was opted. The document analysis technique was used by reviewing the Biology curriculum. For the review, the researcher opted for the nut and bolt approach to analyzing the document. The table of the specification developed from social, economic, and environmental sustainability. This specification table explains the sequence and availability of social, economic, environmental sustainability in the biology curriculum along with the biology textbook.

RESULTS/FINDINGS

According to the criteria established by the Punjab Textbook Board (PTB) Lahore, the secondary school Biology textbook and curriculum are divided for grades 9th and 10th. The researcher overviews the Biology textbook and its curriculum document by biology and observes these sustainability principles. The secondary school biology textbook is divided into six sections (NCTB, 2006).

"Section one: the study of life and biodiversity, section two: cell biology, section three: life processes, section four: continuity in life, section five: ecology, and section six: application of biology".

These six sections follow social, economic, and environmental sustainability in the sequel. When talking about science and technology, the curriculum appreciates the use of technology and science in biology. Technology and science lead students towards problem-solving skills, not only in academic manners but also in life-related manners, leading them towards the socio-economic aspects of life (NCTB, 2006).

"Recognize that the technology resulting from scientific activity influences the quality of lifestyle and economic development through or by improvements in medical/health care, nutrition, agricultural techniques".

Sustainability principles are not discussed clearly in every section. But when we follow themes and subthemes, we find that these principles have been mentioned implicitly in the Biology curriculum. With the help of Blooms' taxonomy, sustainability principles were embedded in the curriculum and taught these principles to the students by using the sustainable pedagogical practices of science teachers.

Table 1: Environmental Sustainability

Sr. no.	Variable of environment sustainability	9th-grade themes no. and name	10th-grade themes no. and name
---------	--	-------------------------------	--------------------------------

1	Natural resources management	1= Introduction to Biology 2= Solving a Biological Problem 8= Nutrition 9= Transportation	10= Gaseous Exchange 11= Homeostasis 16= Man and his Environment
2	Food and farming	3= Biodiversity 6= Enzymes 8= Nutrition 9= Transportation	14= Reproduction 17= Biotechnology 18= Pharmacology
3	Ecological systems	3= Biodiversity 5= Cell Cycle	11= Homeostasis 16= Man and his Environment
4	Waste / water / energy	8= Nutrition 9= Transportation	10= Gaseous Exchange 11= Homeostasis
5	Biodiversity	3= Biodiversity 7= Bioenergetics	16= Man and his Environment 14= Reproduction 15= Inheritance
6	Climate change	1= Introduction to Biology 2= Biodiversity	10= Gaseous Exchange

Table 1 explains that the environmental sustainability principle aligns with six variables. The secondary school Biology textbook and curriculum are divided into six sections considering the sustainability principles (environmental, social, and economic sustainability). All the themes of the Biology curriculum and chapters of the textbook contain these principles separately and simultaneously. After reviewing, the standards and benchmarks explored that every variable of environmental sustainability covers all the themes and chapters of the Biology curriculum and textbook, respectively. Biology curriculum and textbook help to imbue the application and problem-solving skills among students.

Table 2: Social Sustainability

Sr. no.	Variable of social sustainability	9th-grade chapter no. and name	10th-grade chapter no. and name
1	Sustainable communities	1= Introduction to Biology 2= Solving a Biological Problem 3= Biodiversity 6= Enzymes 8= Nutrition	14= Reproduction 15= Inheritance
2	Cultural diversity	1= Introduction to Biology 2= Solving a Biological Problem 3= Biodiversity 5= Cell Cycle 8= Nutrition 9= Transportation	14= Reproduction 15= Inheritance 16= Man and his Environment
3	Sustainability in the built environment	1= Introduction to Biology 2= Solving a Biological Problem 3= Biodiversity 5= Cell Cycle 9= Transportation	16= Man and his Environment 17= Biotechnology 18= Pharmacology
4	Travel, transport, and mobility	1= Introduction to Biology 2= Solving a Biological Problem 5= Cell Cycle 7= Bioenergetics 9= Transportation	10= Gaseous Exchange 11= Homeostasis
5	Intercultural understanding	3= Biodiversity 5= Cell Cycle	14= Reproduction 15= Inheritance
6	Health and wellbeing	1= Introduction to Biology 2= Solving a Biological Problem 6= Enzymes 7= Bioenergetics 8= Nutrition 9= Transportation	10= Gaseous Exchange 11= Homeostasis 12= Coordination and Control 13= Support and Movement 16= Man and his Environment 17= Biotechnology 18= Pharmacology
7	Peace, security, and conflict	5= Cell Cycle 9= Transportation	10= Gaseous Exchange 11= Homeostasis 17= Biotechnology

8	Citizenship, government, democracy	1= Introduction to Biology 2= Solving a Biological Problem	18= Pharmacology 12= Coordination and Control 16= Man and his Environment 17= Biotechnology 18= Pharmacology
9	Human rights and needs	1= Introduction to Biology 2= Solving a Biological Problem	17= Biotechnology 18= Pharmacology

Table 2 explains that the social sustainability principle aligns with nine variables. The sustainability principles in all sections organize in an interdisciplinary manner. All the themes have this sustainability principle separately and concurrently. Human needs and rights were covered effectively and efficiently in the biology curriculum as the overt or hidden curriculum. This curriculum will use science and technology to identify problems and creatively address them in their personal, social, and professional lives.

Table 3: Economic Sustainability

Sr. no.	Variable of social sustainability	9th-grade chapter no. and name	10th-grade chapter no. and name
1	Alternative futures	1= Introduction to Biology 2= Solving a Biological Problem 9= Transportation	10 = Gaseous Exchange 11= Homeostasis 12= Coordination and Control 13= Support and Movement 15= Inheritance 16= Man and his Environment 17= Biotechnology 18= Pharmacology
2	Leadership and change	5= Cell Cycle 9= Transportation	11= Homeostasis 17= Biotechnology 18= Pharmacology
3	Learning organizations	3= Biodiversity 5= Cell Cycle 9= Transportation	10= Gaseous Exchange 11= Homeostasis 12= Coordination and Control 13= Support and Movement 15= Inheritance 16= Man and his Environment 17= Biotechnology 18= Pharmacology
4	Corporate social responsibility	1= Introduction to Biology 2= Solving a Biological Problem 3= Biodiversity	16= Man and his Environment
5	Consumerism and trade	6= Enzymes 8= Nutrition	17= Biotechnology 18= Pharmacology
6	Globalization of economy	3= Biodiversity 8= Nutrition	17= Biotechnology 18= Pharmacology
7	Accountability and ethics	7= Bioenergetics 9= Transportation	12= Coordination and Control 14= Reproduction 15= Inheritance
8	International development	3= Biodiversity 8= Nutrition	11= Homeostasis 14= Reproduction 15= Inheritance 17= Biotechnology 18= Pharmacology
9	Sustainable and ethical tourism	3= Biodiversity	16 = Man and his Environment
10	Population	1= Introduction to Biology 2= Solving a Biological Problem 3= Biodiversity 5= Cell Cycle 9= Transportation	14= Reproduction 15= Inheritance 18= Pharmacology

According to the above table, the economic sustainability principle discusses only a few of the ten variables. Six sections are formed based on disciplinary lines but organized around articles (themes) and subthemes, considering sustainability principles. All the chapters are interdisciplinary. These displayed a sense of curiosity and wondered about the natural world. The Biology curriculum and textbooks demonstrate and foster awareness among students that this has led to new

developments in science and technology and provide guidelines that lead the nation and the economy towards success. Social responsibility, along with the globalization of the economy, international development, and population growth, leads towards economic development and sustainability, helping to support and maintain the economy.

DISCUSSION/ANALYSIS

The secondary school Biology textbooks and curriculum documents were reviewed and explored to see how the National curriculum of Biology for IX-X ensures the importance of students and their learning experiences with their active participation in learning. There have been several academic studies on science subjects, but there has been little work on biology subjects. In Pakistan, textbooks are used frequently by teachers and examiners for preparing and grading exams and test papers (Shah, 2012). Likewise, rote memorization and cramming are encouraged by external examinations in Biology subjects. Moreover, Bhatti, Jumani & Bilal (2015) did essential work to explore the consistency of Biology textbooks and the curriculum. No longer are researchers developing researches on biology curriculums based on sustainability principles. Therefore, the main focus of the curriculum was to develop, foster, and polish the hands-on activities and skills of the students. The principles of sustainability are addressed implicitly rather than explicitly. It promotes critical thinking and stimulates students to devise better future solutions by motivating them to explore different scenarios. The main aim of the Curriculum document for Biology 2006 was:

“Enable all students to develop their capacities as successful learners, confident individuals, responsible citizens, and effective contributors to society.”

The 2006 Biology curriculum aspires to develop such personalities of society who are confident, responsible, and booming in every area of life through science education.

To meet the requirements of the social, economic, and environmental sides of sustainability by ensuring that students can meet these standards through developing relevant and up-to-date career and job training that supports the local and international markets while maintaining socio-economic balance (NCTB, 2006).

When talked about the need for assessment of the Biology curriculum, the curriculum developer and planner focused on a few areas relating to sustainability principles these were:

“Equip young people with the skills they will need in tomorrow's workforce”.

And

“Allow more choice to meet the needs of individual young people”.

Through experiments and learning experiences, the biology curriculum assists students in developing their problem-solving skills, as well as technical and vocational skills, which will prepare them to deal with future difficulties. The biology curriculum, containing sustainability and its principles and its related issues, provides students with a wide variety of concepts to work on and explore. That will enable them to apply their learning in real-life contexts to meet future challenges in society. Incorporating Bloom's taxonomy provides a free space or area to work with and ensures sustainable development in social, economic, and environmental aspects of life. As a result, students encounter experiences that engage them, from surface knowledge to metacognition. Students can transfer their understanding through their all-inclusive, broad experiences and experiments to the practical implementation of ideas as responsible citizens of society, encouraging them towards being responsible citizens of the community.

During the revisions of the Biology curriculum, it was clear that such a framework was required for students to understand and respond intelligibly to their society, environment, and economy and that the agreement was necessary. To meet this need, the curriculum for 2006 includes the problem-based strategy of learning and teaching rather than delivery or lecture-based education. To accomplish this, in-service training will be suggested for teachers to meet the needs of students that will lie towards meeting the needs for everyone to reap benefits from the society to make it a sustainable environment to live in and for work (NCTB, 2006).

“The curriculum introduces the contemporary areas of Biology stressing on connections of study of Biology to real-life problems covering the use of discoveries/innovations in everyday life - in environment, industry, medicine, health, and agriculture. It unfolds the underlying principles that are common to both animals and plants, as well as the inter-relationships of Biology with other areas of knowledge. The new curriculum permits the clear and sequential flow of concepts without jarring jumps”.

Some elements of the National Biology Curriculum Sequence remained classified as "sections" even though modified later.

These sections relate to plant and animal life and various aspects of social and ecological concerns, morality, behavior, and the relationship of biotics with abiotic factors. When organizing themes into divisions, it was crucial to follow the correct sequence.

Each section is linked, which improves students' understanding, comprehension, skills, and ability to apply their knowledge to real-life problems and experiences. A proper connection has been observed between science, technology, and society to support sustainability and its principles in the 21st Century.

"Biology has to be presented as a live and growing body of knowledge rather than a finished product".

CONCLUSION

The result of the study revealed that the curriculum of biology went through a long series of gradual and successive developments. After the inclusion of sustainability in secondary school biology, and as a result, it became more formal, organized, and systematic. However, there is a need to emphasize the memorization and retention of irrelevant materials, themes, or details. The social and economic aspects of biology were neglected in the curriculum's few sections, and the practical work is ignored or performed poorly. When teaching practices of Biology, the aims and objectives were not consistent with the teaching of Biology. While considering the sustainability principles, the themes were inter-connected in the sections and mentioned implicitly rather than explicitly. But the integration of organic science and zoology was not aligned and systematic. The findings of the study shed new light on the progressive and applicable implementation of principles of sustainability. It was suggested that the explicit and implicit inclusion of the sustainability principle in the biology curriculum in a systematic and coordinated way would help students cope with the needs and demands of a future society. The findings suggest a need for progressive alignment and integration of sustainability principles into the biology curriculum. Necessary resources are provided to make it more applicable and valuable for students. The biology curriculum in secondary school should be revised and improved and reflect our social, Islamic, environmental, and economic needs.

LIMITATION AND STUDY FORWARD

The researcher uses the Qualitative approach to explore the Sustainability principle in the Biology curriculum by reviewing the document of the Biology curriculum along with its all components i.e., standards, benchmarks, competencies, objectives, and aims. There will be a need to review the Biology curriculum quantitatively by indicating the percentage or weightage of the covered sustainability principles. Subjects other than Biology will also need to investigate sustainability principles to make the curriculum more stable, symmetric, and systematic.

ACKNOWLEDGEMENT

Thanks to ALLAH ALMIGHTY after a long and laborious time, today I am able to accomplish my research article successfully

I would especially like to mention my supervisor, Dr. Muqaddas Butt, for her guidance experience throughout in making this article and especially, her invaluable suggestions that helped me to structure this article.

I am also thankful to my affectionate parents late Zarar Hussain and Shahnaz Akhtar, without their support this project would not have been possible. A special note of thanks goes to my brothers M. Faisal Zarrar, M. Abdullah and Sister Ayesha Abdullah, and Dr. Tahir Mehmood, who always supports me and motivates me to accomplish my work. I am also thankful to my friends Atika Aziz for her financial support, Ambreen Siddique and Ayesha Khalid who gave their time and appreciation.

Thanks to ALLAH, Thanks to all

AUTHORS CONTRIBUTION

Naila Zarar completed this work under the supervision, kind review of Dr. Muqaddas Butt, and the article was reviewed and financially supported by Aatika Aziz.

REFERENCES

1. Abimbola, Isaac Olakanmi; Baba, Salihu (1996) Misconceptions and Alternative Conceptions in Science Textbooks: The Role of Teachers as Filters. *American Biology Teacher*, 58(1), 14-19.
2. Atkinson, G., Dietz, S., & Neumayer, E. (2007). *Introduction: Handbook of sustainable development*. Elgar original reference. <https://doi.org/10.4337/9781847205223>
3. BAKER, J. J. (2008). Exploring 'living curricula': Biocentric complexity and education. *Paper presented at the Proceedings of the 2008 Complexity Science and Educational Research Conference*. https://www.researchgate.net/publication/262042006_Education_for_Sustainability_Implications_for_Curriculum_and_Pedagogy
4. Barth, M., Michelsen, G., & Sanusi, Z. A. (2011). A review on higher education for sustainable development-looking back and moving forward. *Journal of social sciences*, 7(1), 100-103. <https://doi.org/10.3844/jssp.2011.100.103>
5. Bradley, J. (2005). Chemistry education for development. *Chemical Education International*, 7.
6. Bhatti, A. J., Jumani, N. B., & Bilal, M. (2015). Analysis of Alignment between Curriculum and Biology Textbook at Secondary Level in Punjab. *Pakistan Journal of Social Sciences (PJSS)*, 35(1).

7. Eilks, I. (2002). Teaching 'biodiesel': a sociocritical and problem oriented approach to chemistry teaching and students' first views on it. *Chemistry Education Research and Practice*, 3(1), 77-85. <https://doi.org/10.1039/B1RP90041B>
8. Eilks, I., Nielsen, J. A., & Hofstein, A. (2014). Learning about the role and function of science in public debate as an essential component of scientific literacy. *Topics and trends in current science education* (pp. 85-100): Springer. https://doi.org/10.1007/978-94-007-7281-6_6
9. Feierabend, T., & Eilks, I. (2010). Raising Students' Perception of the Relevance of Science Teaching and Promoting Communication and Evaluation Capabilities Using Authentic and Controversial Socio-Scientific Issues in the Framework of Climate Change. *Science Education International*, 21(3), 176-196.
10. Feierabend, T., Jokmin, S., & Eilks, I. (2011). Chemistry teachers' views on teaching 'climate change'-an interview case study from research-oriented learning in teacher education. *Chemistry Education Research and Practice*, 12(1), 85-91. <https://doi.org/10.1039/C1RP90011K>
11. Gadotti, M. (2010). Reorienting education practices towards sustainability. *Journal of Education for Sustainable Development*, 4(2), 203-211. <https://doi.org/10.1177/097340821000400207>
12. Goodson, I. (2010). Curriculum reform and curriculum theory: A case of historical amnesia. *Cambridge Journal of Education*, 19(2), 131-141. <https://doi.org/10.1080/0305764890190203>
13. Gough, S., & Scott, W. (2003). Sustainable development and learning: Framing the issues. *Routledge*. Book ISBN 9780415276481. <https://doi.org/10.4324/9780203464625>
14. Hofstein, A., Eilks, I., & Bybee, R. (2011). Socio-scientific issues as a necessary base for sustainable chemistry education. *International Journal of Mathematics and Science Education*, 9, 1459-1483. <https://doi.org/10.1007/s10763-010-9273-9>
15. Holbrook, J., & Rannikmae, M. (2007). The nature of science education for enhancing scientific literacy. *International Journal of science education*, 29(11), 1347-1362. <https://doi.org/10.1080/09500690601007549>
16. Holdsworth, S., Wyborn, C., Bekessy, S., & Thomas, I. (2008). Professional development for education for sustainability. *International Journal of Sustainability in Higher Education*, 9(2), 131-146. <https://doi.org/10.1108/14676370810856288>
17. Huckle, J. (2005). Education for sustainable development: A briefing paper for the Teacher Training Agency. *Final draft June*. www.ttrb.ac.uk/viewArticle2.aspx?contentId=11324
18. Isenhour, C. (2010). On conflicted Swedish consumers, the effort to stop shopping and neoliberal environmental governance. *Journal of Consumer Behaviour*, 9(6), 454-469. <https://doi.org/10.1002/cb.336>
19. Moore, J. (2005). Seven recommendations for creating sustainability education at the university level. *International Journal of Sustainability in Higher Education*, 6(4), 339-339. <https://doi.org/10.1108/14676370510623829>
20. Nolet, V. (2009). Preparing sustainability-literate teachers. *Teachers College Record*, 111(2), 409-442.
21. [NCTB] National Curriculum and Textbook Board (2006). *Curriculum and Syllabus, Secondary Level (Grades IX-X) [in Pakistan]*. Islamabad: Federal Ministry of Education. http://bisep.com.pk/downloads/curriculum/Grades-IX-X/pk_sc_bsc_2006_eng.pdf
22. Pauw, J., Gericke, N., Olsson, D., & Berglund, T. (2015). The effectiveness of education for sustainable development. *Sustainability*, 7(11), 15693-15717. <https://doi.org/10.3390/su71115693>
23. Pawłowski, A. (2008). How many dimensions does sustainable development have? *Sust. Dev.*, 16, 81-90. <https://doi.org/10.1002/sd.339>
24. Sauvé, L. (1996). Environmental education and sustainable development: A further appraisal. *Canadian Journal of Environmental Education*, 1, 7-34.
25. Schultz, P. W. (2011). Conservation means behavior. *Conservation Biology*, 25(6), 1080-1083. <https://doi.org/10.1111/j.1523-1739.2011.01766.x>
26. Shah, S. F. (2012). An investigation into the alignment between the Government's dictated English language curriculum and the textbook mediated classroom practice at the secondary level in Pakistan. A Master of Philosophy thesis at Nottingham Trent University.
27. Sterling, S. (2003). Whole systems thinking as a basis for paradigm change in education explorations in the context of sustainability. *University of Bath*. Ph.D. Thesis.
28. Tilbury, D., Keogh, A., Leighton, A., & Kent, J. (2005). A national review of environmental education and its contribution to sustainability in Australia: Further and higher education. *Australian Research Institute in Education for Sustainability (ARIES)*.
29. UN DESD. (2005). *UN decade of ESD: UNESCO*. Report. <https://en.unesco.org/themes/education-sustainable-development/what-is-esd/un-decade-of-esd>
30. UNESCO. (2004). *The quality imperative: Education for all global monitoring report 2005*: Unesco. Report <https://en.unesco.org/gem-report/report/2005/education-all-quality-imperative>
31. UNESCO. (2005). Teaching and learning geography in the UN decade of education for sustainable development. *Geographical Education*, 18, 6.
32. UNESCO. (2009). A United Nations Decade of Education for Sustainable Development (2005-14) What Difference will it Make? *Journal of Education for Sustainable Development*, 3(1), 87-97. <https://doi.org/10.1177/097340820900300116>

33. Vare, P., & Scott, W. (2007). Learning for a change: Exploring the relationship between education and sustainable development. *Journal of Education for Sustainable Development*, 1(2), 191-198.
<https://doi.org/10.1177/097340820700100209>
34. Wheeler, K. (2000). Sustainability from five perspectives. *Education for a sustainable future*, 2-6.