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ANALYSIS OF CLIMATE CHANGE IN THE CONTENT OF GENERAL SCIENCE TEXTBOOK WITH REFERENCE TO SDGS AND THE 3RS AT ELEMENTARY SCHOOL LEVEL

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Abstract
The present study aimed to analyze the General Science textbook of Grade 8 published by the Punjab Curriculum and Textbook Board (PCTB), Lahore, based on the Single National Curriculum (SNC) 2022, in the context of climate change content and its alignment with the United Nations Sustainable Development Goals (SDGs) and the 3Rs framework of Reduce, Reuse, and Recycle. A qualitative content analysis method was used. The conceptual framework of the study was drawn from three integrated pillars: Environmental Literacy and Action Competence theory, the relevant UN Sustainable Development Goals (SDG 4, SDG 12, SDG 13, SDG 15), and the 3Rs as behavioral competency indicators. Results showed that the textbook adequately addresses climate change concepts, including the greenhouse effect, global warming, deforestation, fossil fuels, and overpopulation, with sound scientific accuracy and supportive visual materials. Regarding SDG alignment, SDG 15 (Life on Land) and SDG 4 (Quality Education) are moderately addressed, while SDG 13 (Climate Action) and SDG 12 (Responsible Consumption) are insufficiently developed. The 3Rs of Reduce, Reuse, and Recycle are mentioned collectively in a single sentence (4Rs strategies of Refuse-reduce-reuse and recycle should be adopted) under the heading of 4R strategies without any definition, elaboration, student activity, or assessment item. Practical exercises, inquiry-based activities, and a dedicated 3Rs section may be added to the textbook to develop environmental action competencies among students. The present research is beneficial for improving the General Science textbook by incorporating deeper climate change content, stronger SDG alignment, and meaningful 3Rs integration that will help students develop as environmentally responsible citizens.

Introduction

The way curriculum and the educational process are carried out is changing because of new knowledge, evolving environmental realities, and rising global temperatures. In this context, climate change education could be viewed as one of the most pressing educational requirements of the twenty-first century. Focus has been on providing students with skills and knowledge to comprehend, respond, and mitigate climate change, and education systems across the globe, especially in the developing nations, should incorporate climate change

content in their curriculum to address the reality of a warming planet.

The concept of learning in the twenty-first century can be attributed to the capabilities of students to address environmental issues in their daily lives and subsequent engagements. One of the basic behavioral competencies in environmental education is the 3Rs, Reduce, Reuse, and Recycle, which combines scientific knowledge with everyday behavior. Likewise, the United Nations Sustainable Development Goals (SDGs) are a normative framework of a globally recognized system on which educational material can be assessed in terms of its contribution to sustainable development. A research question that needs to be answered is whether climate change material in the PCTB Grade 8 General Science textbook is sufficient to build 3R competencies and is in line with the corresponding SDGs.

The General Science textbook in Grade 8 published by the Punjab Curriculum and Textbook Board (PCTB) as part of the Single National Curriculum (SNC) 2022 is the main instructional tool of millions of Pakistani students in Punjab. As one of the most important components of the curriculum, the textbook is an important aspect of the educational process and can contribute to the achievement of the desired learning outcomes (Ornstein and Hunkins, 2017). Scientific textbook is a particular resource that can be used by the student when necessary; the information provided in it can directly influence the environmental attitudes, values, and behaviors.

The role of textbooks in education at any stage cannot be overestimated, as the information included in them may have a direct impact on students that is not possible with other learning materials (Aldahmash et al., 2016; Dunne et al., 2013). A research question that needs to be answered is whether climate change material in the PCTB Grade 8 General Science textbook is sufficient to build 3R competencies and is in line with the corresponding SDGs.

Therefore, the present research was intended to investigate the extent to which the topic of climate change is covered in the textbook content of the General Science Grade 8 curriculum developed by the Punjab Curriculum and Textbook Board in Pakistan, and whether this content is preparing students to Reduce, Reuse, and Recycle according to the SDGs.

Objectives

1. To analyze the climate change content in the General Science textbook of Grade 8 (PCTB, SNC 2022).
2. To evaluate the alignment of climate change content with relevant United Nations Sustainable Development Goals: SDG 4 (Quality Education), SDG 12 (Responsible 3. Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land)
3. To assess the degree to which the textbook integrates the 3Rs - Reduce, Reuse, and Recycle as assessed environmental literacy competency.

Conceptual Framework of Research

To analyze the textbook of General science (Grade 8), the current research study used a three-pillar conceptual framework, which included: (1) Environmental Literacy and Action Competence theory, (2) the United Nations Sustainable Development Goals as learning standards, and (3) the 3 Rs as behavioral competency measures. These three pillars make up the analytic prism used on the textbook material on climate change.

Environmental Literacy and Action Competence: This study is based on Environmental Literacy (EL) which according to Roth (1992), is the ability to perceive and interpret the relative health of the environmental systems and appropriate action is taken to maintain, restore or improve the health of the systems. Environmental literacy involves four dimensions (related to each other) namely knowledge (knowledge of ecological systems and the relationship between humans and the environment), affect (values and attitudes about the environment), skills (skills needed to explore and analyze environmental problems), and behavior (pro-environmental behavior).

Jensens and Schnacks (1997) theory of Action Competence builds on this theory by stating that effective environmental education should

not only inform students but also build their ability and desire to act. The action-competent students have the knowledge to comprehend an issue in the environment, the values to be concerned about, and the actual behavioral repertoire to solve it. This framework is applied to determine whether the climate content in the textbook produces students who act and not students who know.

Sustainable Development Goals (SDGs): The 2030 Agenda of Sustainable Development by the United Nations is an internationally recognized system of assessing the content of education. Four SDGs are directly related to this study. SDG 4 (Quality Education) is a demand of sustainable development and world citizenship education. SDG 12 (Responsible Consumption and Production) facilitates waste minimization by preventing, reducing, recycling, and reusing it, the direct policy basis of the 3Rs. The SDG 13 (Climate Action) requires enhancement of education, awareness creation, and human capacity regarding mitigation of climate change, adaptation, and reduction of its impact. The SDG 15 (Life on Land) focuses on the preservation of the land ecosystem, cessation of deforestation, and safeguarding of biodiversity. All SDGs are employed as an evaluative criterion with the help of which the contents of the textbook are evaluated.

The 3Rs as Behavioral Competency Indicators: The 3Rs, or Reduce, Reuse, and Recycle, are a chain of desirable behavior in sustainable consumption and waste disposal. The most desirable is Reduce (reducing the amount of resources used at the source); Reuse (excluding more use of a product) is second; and Recycle (transforming waste materials into other substances) is third (European Environment Agency, 2019). The 3Rs are used as behavioral competency indicators in environmental education, which are observable, teachable, and can be applied instantly and in everyday life. The operational behavioral cause between abstract climate change (knowledge of greenhouse gases) and environmental agency (decision to decrease single-use plastic) is the 3Rs. The textbook is evaluated regarding the definition, explanation, examples, and reinforcement of each R, as well as its presence in assessment.

The three pillars are dynamically related to each other: Environmental Literacy gives the theoretical educational rationale; the SDGs give the normative policy rationale; and the 3Rs give the specific behavioral competency indicators. A textbook that scores high in all three pillars would result in students who know climate change in scientific terms, view it as an urgent global problem that needs to be addressed together in accordance with the internationally established objectives, and have behavioral instruments, which are specific and practical, 3Rs to solve it in their real lives.

Literature Review

The 2030 Agenda of Sustainable Development, which was adopted by all United Nations Member States in 2015, offers a common template of peace and prosperity of people and the planet now and in the future. The 17 Sustainable Development Goals (SDGs) are an emergency appeal to do something on a global partnership between the developed and developing nations. They understand that poverty and other forms of deprivation should be eliminated in tandem with measures that will promote health and education, inequality, and economic growth, not to mention climate change and efforts to conserve our oceans and forests.

SDG 4 secure universal and fair quality education and life-long learning opportunities to all, SDG 12 secure sustainable consumption and production patterns, SDG 13: Immediate action against climate change and its effects.

The 3Rs is a waste management hierarchy, and it is abbreviated as reduce, reuse and recycle. These are the most desired and three major principles of waste management that strive to reduce the quantity of waste that is generated and make better utilization of the resources that is found in the waste materials.n waste materials. This methodology consistently integrated into MSW waste reduction and recycling will reduce the landfill waste and will be the primary algorithm in achieving a zero waste objective or at least a considerable reduction of the waste (Wahied et al 2022) The

waste is referred to as the 3 Rs, which sorts waste management techniques based on their desirability regarding zero waste target or at least a significant reduction of it, as the chat attracts by United Nationgional Development (UNCRD).

Reduce: This is nothing but to avoid wastages, as the most efficient method of avoiding wastages is not to create it. Reduce in the 3Rs also implies using less, either by using less in the initial stage or using less effectively (Fahzy 2014). This may involve such aspects as carrying reusable shopping bags as opposed to disposable bags, switching off lights when they leave a room and repairing instead of discarding stuff.The reduction efforts (such as prevention, reducing and reuse) are intended to minimize waste at the point of origin by redesigning products or altering the production and consumption trends (Adedipe et. al, 2005). Waste source reduction initiatives (including prevention, reducing, and reuse) aim to reduce waste at its source by redesigning products or changing production and consumption patterns (Adedipe et. al, 2005).

Reuse: Re-use entails any mode of operation whereby object or parts that are not waste are re-used in the same way they were conceived and created to be used. The reuse in waste management may also be applied to recovery activities that analyze, clean up or repair of products or components of products that become wasteful so that they can be reused without additional preprocessing (Ismail and Lino, 2012).

Recycle: In most developed countries, the common usage of the term recycling is the intensive gathering and reuse of the daily wastes in the form of empty drinks containers (Jasem, 2005).This chain normally includes the following steps in recycling; Collection, Sorting, Cleaning, Crushing and Grinding, Melting and forming, and the reuse of the material in a new product.rage containers (Jasem, 2005). The recycling process are usually in this chain; Collection – Sorting – Cleaning - Crushing or Grinding - Melting and forming - Reprocessing into a new product. According to word bank (2009), recycle Recovery operations entail use of waste materials to process products, materials or substances whether used in their original use or in alternative uses.er uses. This also involves re processing of organic materials.

Climate change is defined as the long-term variation of the weather patterns and temperatures. These changes may be natural caused by variations in the activity of the sun or massive volcanic activities. The heat production of the sun through greenhouse gas emission of fossil fuels causes the world to be covered with a blanket, which traps the heat.

Carbon dioxide and methane are the key greenhouse gases that are responsible to the climate change. These are as a result of driving a car by the use of gasoline or heating a building by the use of coal such as an example. Carbon dioxide may also be emitted by clearing up land and cutting down forests. The oil and gas activities and agriculture are the biggest contributors of methane. Some of the primary industries that cause greenhouse gases include energy, industry, transport, buildings, agriculture, and land use.

The transition between the period of industrial development of the twentieth century and the climate crisis of the twenty-first century is accompanied by the increased awareness that the knowledge and skills required to be an environmental citizen should be taught at school since childhood (Kivunja, 2015). The 3Rs, climate change education (CCE), and SDG-aligned learning are three of the most important current priorities of the curriculum. Life skills can be described as a general set of skills that help individuals to cope effectively with the challenges they meet in their daily lives within the social, cognitive, and personal spheres (UNESCO, 2013; WHO, 1999); the environmental action competencies, such as the 3Rs, can be viewed as a specialized subset of skills in life.

Climate change literacy is critical in the case of secondary students since it provides them with insights that are not limited to academic performance. These skills will enable students to make sound decisions, raise awareness about the environmental issues, collaborate with other individuals to deal with common problems, and adjust their actions, which will make them better equipped to become

responsible adult citizens (UNESCO, 2021). This information on climate change found in textbooks stimulates critical thinking, environmental values, and personal sense of agency that are believed to play a crucial role in community involvement and sustainable development.

Secondary textbooks play a very important role in assisting students to gain environmental competencies since they allow them to gain systematic, structured information, which builds conceptual knowledge, analytical, and behavioral disposition (Khan, 2021). Studies have shown that including climate change material and 3Rs in science classes improves the environmental literacy of students and equips them with environmental issues in the real world (Chen and Wang, 2019). Besides, it has been demonstrated that science textbooks of proper structure can facilitate holistic environmental development besides scientific knowledge (Ibrahim, 2018; Olorundare and Mji, 2021). When considering textbooks in terms of SDGs and 3Rs, it is possible to determine how well the learning resources help students develop the environmental competencies that would allow them to live sustainably (Abrahams et al., 2022).

The textbooks are important in the general science education towards the formation of environmental literacy, values, and behaviors in the students. It has been shown that incorporating environmental problems, such as climate change and sustainable consumption, into scientific studies raises the ecological awareness of the students and makes them aware of the environmental issues that they will face in practice (Brown and Lee, 2018). These skills are referred to as being necessary in assisting students in making environmental choices as well as preparing them to make a positive contribution to their society and communities (Smith, 2020).

Several studies have been conducted to examine how to incorporate the themes of environmental and sustainability in science textbooks in secondary level. Ali and Shah (2017) analysed the 6-8 grade science textbooks in Khyber Pakhtunkhwa in Pakistan and discovered that the coverage of the environmental topics was biased, and the science, technology, and society interaction were not addressed extensively. Hussain and Raza (2021) suggested that the incorporation of locally relevant knowledge in general science textbooks in the secondary level in Pakistan is important. As Kodan and Bozdemir (2014) analyzed the primary science curriculum purchase and found that forty-two of them were connected with environmental education, it is possible to state that the environmental material in grades and curriculum cycles is significantly different.

Jones (2016) justifies the introduction of the environmental action skills into the secondary science education to build the problem-solving, critical thinking, and communicational skills in the framework of sustainability. According to Hilton and Pellegrino (2012), numerous transferable environmental skills like 3Rs behaviors can be well trained through education by integrating them into an instructional system. The content analyses of textbooks in South Asia (Ahmed, 2021; Bhatt and Bhatt, 2020) demonstrate the same tendencies in their content: the material on climate is present but tends to be descriptive, as opposed to action-oriented and seldom connects the scientific concepts with the daily behavioral decisions students can make with the help of the 3Rs.

In terms of the SDGs integration into school curricula, Morales-Lopez et al. (2022) discovered that an amount of national textbooks cover the SDGs individually on a tangential manner, but not systematically. It is especially in the developing countries that SDG 12 and SDG 13 are not represented in science curricula in a central way, yet they are very central to the environmental behaviors that can be embraced by the young people (Leicht, Heiss, and Byun, 2018). The current research is based on this literature by providing an analytical framework of a dual SDG-3Rs lens to the PCTB General Science teaching book, Grade 8 in order to add to the empirical data on climate change education in Pakistani schools.

Methodology

General Science textbook of Grade 8th of Punjab Curriculum and Textbook Board

(PCTB) Lahore, published under the single national Curriculum 2022, was analyzed in the context of climate change, SDG alignment, and 3Rs integration. The content in textbook was analyzed using the qualitative content analysis method.

Data Analysis

Brief Description of the General Science Textbook (Grade 8)

Single national curriculum Punjab Curriculum and Textbook Board (PCTB) Grade 8 General Science textbook Lahore is on a single national curriculum 2022. It comprises of 169 pages divided into several chapters that discuss the issues of different disciplines of science such as ecology, matter, atoms and molecules, chemical reactions, human systems and space science. The chapters contain a list of the learning outcomes of the students, detailed content, figures and photographs, some main points, do you know boxes, student activities, and exercise questions. The questions in the end of the chapters are exercise questions, which consist of multiple choice questions, short answer questions, long answer questions, and mini exercises. The chapter of particular interest to the current study is chapter 1 (Ecology) as it includes the principal discussion of the topic of climate change, global warming, and environmental solutions that is presented throughout the textbook.

Book link: https://alrazipublications.com/wp-content/uploads/2023/07/General-Science-8-PTCB.pdf

Climate Change Content

Table 1: Summary of Climate Change Content in PCTB General Science Grade 8

Content area	section	present	remarks
Green house effect and gases	1.3.1	Yes	Good- diagram included
Global warming	1.3.1	Yes	Clearly defined
Effects of global warming	1.3.1	Yes	Diagrams included
Fossil fuels (cause)	1.3.2	Yes	Good-health links noted
Deforestation	1.3.2	Yes	Good-local context (changa manga)
Over population (CAUSE)	1.3.2	Yes	Moderate-energy demand focus
Reducing pollution (solutions)	1.4.1	Yes	Good-multiple strategies
4R strategies mentioned	1.4.1	Yes	Weak-no elaboration
Plantation/reforestation	1.4.2	Yes	good
Endangered species/biodiversity	1.4.3	Yes	Good- Pakistan specific example
Students activities on 3 Rs	Activity		Not directly addressed

Table 1 showed that ,in the textbook, the information on climate change is condensed into Chapter 1 (Ecology), namely, 1.3 and 1.4. Section 1.3 (Environmental Problems) introduces the concept of environmental problems that is the global warming. The textbook states that certain gases present in the atmosphere like carbon dioxide (CO_2), methane (CH_4), nitrogen oxide (NO_2) oxides and water vapour reflects some of the heat that the earth would have reflected causing an increase in atmospheric temperature. These gases are also called the green house gases and the effect is termed as green house effect. It is rightfully stated in the textbook that the amount of greenhouse gases in the atmosphere is increased by the human processes that involve the burning of the fossil fuel that

stimulates the greenhouse effect and makes the World warmer.

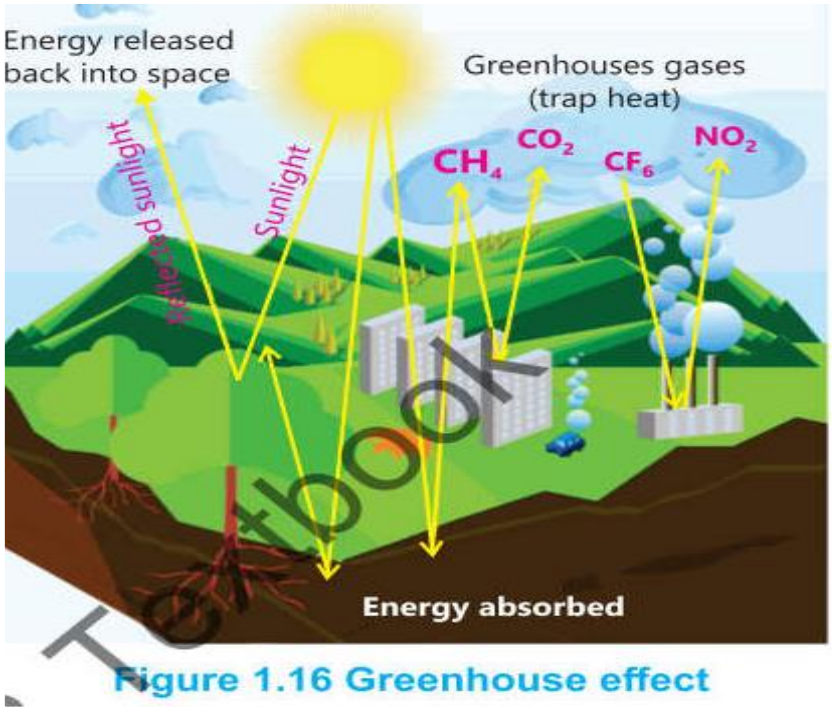

Figure 1: Greenhouse effect

The effects of global warming are described in the correct level of scientific understanding with regard to Grade 8: the melting of ice in polar areas and mountain glaciers, increase in sea levels, flooding of the low-lying coastal areas, and alteration of climates in various parts of the world. The greenhouse mechanism is visually represented in a well-designed diagram (Figure 1.16) and a photographic collage (Figure 1.17) demonstrates such effects as wildfires, industrial emission, floods, drought, and glacial melt, which is an effective visual reinforcement of the fact that climate change is an immediate visible reality. An information box (Do You Know) is used to tell the students that the ozone layer in the upper atmosphere prevents ultraviolet rays of the Sun getting to Earth, which enhances the value of atmospheric literacy to the section.

Table 1 also depicts that in section 1.3.2, three key contributors of global warming have been identified. First, burning of fossil fuels; as fossil fuels are burnt in industries and automobiles, they produce greenhouse gases such as carbon dioxide. There are also air pollutants, carbon monoxide, sulphur dioxide, oxides of nitrogen and their effects on human health such as headaches, brain damage, respiratory issues, pneumonia and lung cancer introduced in the textbook. Second, deforestation: the textbook describes that trees absorb CO 2 by their own photosynthesis; hence the deforestation process lowers the rate of CO 2 absorption but raises the rate of CO 2 emission to the atmosphere. A localization note by the Pakistani people brings out Changa Manga forest in District Kasur as a man-created forest, which is an appreciable attempt to localize the world concepts. Third, overpopulation: the textbook relates the increased human population with the demand to use more fossil fuels to emit more greenhouse gases. In this section, the writer has presented sound science communication that is suitable at the grade level.

The solutions to the environmental problems are offered in the Section 1.4 (Solutions to Environmental Problems) in three categories, such as reducing pollution (1.4.1), plantation (1.4.2), and protection of endangered species (1.4.3). Section 1.4.1 suggest several actions such as public transport, fuels that are sulphur and lead free, products that are CFC free and an imperative adoption of 4RF strategies of

Refuse-Reduce-Reuse-Recycle as a strategy of conserving resources.

In section 1.4.2, the author highlights plantation as a solution to air quality and climate. The 1.4.3 section talks about the threatened species (snow leopard, Indus river dolphin, Markhor) and government conservation efforts, making the loss of biodiversity directly related to global warming and pollution.

Figure 1.20 Reducing Pollution

Figure 1.21 Replantation

Figure 2: Reducing pollution and replantation

The chapter has two student exercises and a mini exercise. Activity 1.1 requires students to follow, color and explain how children are making the environment clean and healthy and the pictures include children planting trees and picking wastebins. Activity 1.2 will require the students to locate images of endangered species. The Mini Exercise challenges the students to describe the consequences of global warming on the life of the Earth the knowledge-recall task. The Key Points section of the chapter provides the summary of the carbon and oxygen cycles, global warming, and greenhouse effect, yet it does not provide the 4R strategies as the key learning points.

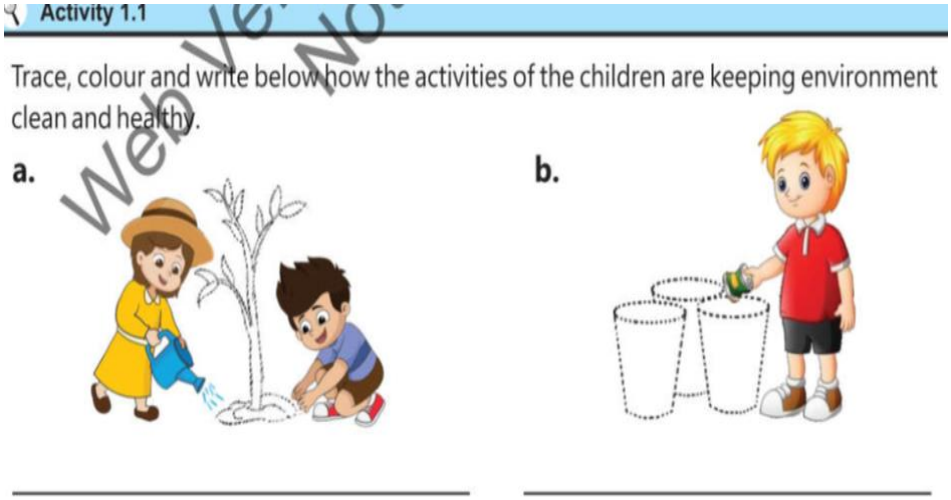

Figure 3: Activity to keep environment clean

SDG Alignment

Table 2: SDGs Alignment of Climate Change Content in PCTB Grade 8 Textbook

SDGs	Key concepts	Textbook Alignment
SDG 4: Quality Education	4.1 ESD and global citizenship	Ecology chapter supports environmental awareness.
SDG 13: Climate Action	13.3 climate education and capacity	Core concepts covered: capacity building absent
SDG 12: Responsible Consumption	Reduce waste via 3 Rs	4Rs mentioned in one sentence, not developed as environmental competency.
SDG 15: Life on Land	Forests, biodiversity	Deforestation, endangered species covered with local context.

Table 2 describes SDG 4 Quality Education. The ecology chapter is also a logical introduction: it introduces the vocabulary of climate change, discusses the causes and solutions in an easy-to-understand format in Grade 8, and also provides local examples in accordance with the contextually situated education. But to have sustainability in quality education, it is necessary not only with knowledge but also values, attitudes, and competencies (UNESCO, 2017). The expository nature of the textbook which entails giving facts to students to memorize restricts its ability to correspond with the transformational vision of SDG 4. Problem-solving activities and inquiry based activities associated with climate action are mostly missing.

SDG 13 Climate Action: The textbook correlates well with the awareness dimension: the students are well informed about the causes of global warming, effects, and greenhouse gases. The photo collage depicting the effects of climate conveys the sense of urgency. The mitigation and the adaptation dimensions are however underdeveloped. The textbook provides solutions but does not build the ability of the students to plan, implement and assess the solutions. SDG 13 needs action competent young citizens and not just well-informed citizens.

SDG 12 Responsible Consumption and Production: This SDG has been least developed in the textbook. The one sentence reference to 4R strategies with no definition, expansion, or actions does not build the responsible consumption competencies SDG 15 needs. Grade 8 students are of age where consumer habits are developed, and a curriculum that only talks of the 3Rs is missing a high leverage opportunity.

SDG 15 Life on Land: The deliberations are deforestation, soil erosion, and endangered species, which are well in line with SDG 15 targets. The specific endangered species (snow leopard, Indus river dolphin, Markhor) in Pakistan and the government conservation policies are a sign of locally-grounded SDG 15 content, which is a strength.

3Rs Integration

Table 3: 3Rs Integration in PCTB Grade 8 General Science Textbook

Indicator	Reduce, reuse and recycle
Mentioned by name	Yes (1 sentence, 4Rs strategies of Refuse, Reduce, Reuse, and recycle should be adopted.)
Defined /explained and example provided	No
Linked to the local Pakistani context	No
Student activity reinforces it	Implicit only
Included in key points	No

Table 3 depicts that Section 1.4.1 refers to the 3Rs- Reduce, Reuse, Recycle in a single sentence: 4R plans of Refuse-Reduce-Recycle-Recycle of resources should be implemented. The textbook does not elaborate on it any further. 3Rs integration and analysis against nine indicators show that there are gaps on all the three Rs.

Reduction: The reduction is not described or defined anywhere in the textbook. Learners are not instructed on what reduction entails in everyday life, what particular actions are a part of reduction, or how reducing consumption is related to achieving a reduction in greenhouse gas emissions. The instinctive way to connect the idea of overpopulation (Section 1.3.2) with the reduction of individual consumption is completely overlooked.

Reuse: There is no definition or explanation of reuse. The idea of product lifecycle extension in terms of reuse, that is, repairing products, reusing materials, not using single-use products, is not elaborated anywhere in the chapter. This is a major void since reuse is, perhaps, the most available of the 3Rs to Pakistani students in the socioeconomic environment, where repair culture already is deeply embedded in several communities.

Recycle: Recycle is not defined or elaborated. Students are not shown what recycling is, what to put in the recycling bin, how recycling saves landfills and conserves energy and how recycling is related to greenhouse gas emissions. There is no relation drawn with the concepts of climate change that were discussed in the first part of the chapter to recycling.

The student activities in the chapter fail to strengthen the 3Rs: Activity 1.1 implicitly deals with waste disposal but does not instruct the 3Rs as a model, and Activity 1.2 deals with endangered species. Chapter exercises and the Mini Exercise do not have any questions touching on the 3Rs. The 4R strategies are not listed in the section of the Key Points, which further marginalizes their curricular position. The 3Rs are therefore textbook knowledge to which students are exposed to once and in a passing manner without acquisition of any competency.

Discussion

The research studies have also found that the majority of educational institutions rely on textbooks to teach science subjects, and textbooks are seen as curriculum (McDonald, 2016). In this way, the current research presented the Grade 8 Punjab Curriculum and Textbook Board Lahore General Science textbook in the framework of the climate change coverage, SDGs compatibility, and the incorporation of 3Rs in the study using a qualitative content analysis. The three pillars of analyses, which include, the Environmental Literacy and Action Competence theory, the respective SDGs and the 3Rs as the behavioral competency markers are the basis of the current research.

The Grade 8 General Science textbook had sequenced and well explained climate change contents. It describes the green house effect and global warming using appropriate grade level, causes, fossil fuel, deforestation, and overpopulation and provided solutions: cut down the pollution, plantation, and protection of endangered species. Some of the strong visual materials in the book include a diagram of a greenhouse effect, a photo collage of the effects of global warming and the resources locally important which are Changa Manga forest and endangered species in Pakistan. The open-ended questions in the textbook (i.e., when students are requested to expound on the effects of global warming on the life on the earth) are advantageous because they allow students to think in a scientific way to become more interested in science and think profoundly (Örnek and Alaam, 2024).

SDG 15 (Life on Land) and SDG 4 (Quality Education) are discussed in the textbook on medium to high levels, particularly on its deforestation, biodiversity, and ecological data. Nevertheless, the alignment with SDG 13 (Climate Action) is also not complete: climate awareness is well-developed, and the action competence dimension, which Target 13.3 presupposes, is not developed. The SDG in the textbook that is the least compatible is SDG 12 (Responsible Consumption). Similar patterns

were observed by Morales-Lopez et al (2022) across the world with SDG 12 and SDG 13 having an average underrepresentation in the science curricula of developing countries. Chiappetta and Fillman (2007) think that the textbooks can be useful in providing guidelines to the teachers in developing teaching strategies to enhance learning among the students provided the textbook itself does not foster the responsible consumption competencies, the teachers have nothing to bank on.

The most important deficiency in the textbook covering of climate change is the 3Rs. The single sentence mention of the 4R strategies without any further explanation, description, practice or evaluation does not develop any competency of the Reduce, Reuse or Recycle. In this case, action-competence and personal empowerment which is the capacity to use less, reuse and recycle waste materials needs to be taught, exemplified and practised (Jensen and Schnack, 1997). The textbook text and illustrations have to a certain degree facilitated the transmission of environmental concepts, though, the exercises provided are exceptionally few to form the 3R behavioral competencies. Danczak et al. (2017) and Yoon et al. (2014) also supported the idea of problem-solving approaches and practical activities in the science education, but these activities were greatly absent in the case of the 3Rs in the provided textbook.

The General Science textbook does not speak about the involvement of the students in the environmental action. The involvement of the students in environmental audit, waste management programs, and community involvement can be added to increase the degree of environmental agency and 3R competency among the students. Another opinion that Okan and Kaya (2023) shared is that there is a necessity to incorporate social and practical aspects of science with the epistemic and cognitive ones to realize the whole scientific development.

Conclusion

General Science textbook of Grade 8 of Punjab Curriculum and Textbook Board (PCTB) Lahore was analyzed in the context of three pillars, such as, coverage of the topic of climate change, compliance with SDG (SDG 4, SDG 12, SDG 13, SDG 15), and integration of 3Rs (Reduce, Reuse, Recycle). The concept of climate change: greenhouse effect, global warming, deforestation, fossil fuel, overpopulation, and environmental solutions are taken in a rather scientific way, with an adequate number of visual aids, and a commendable localization: Changa Manga forest and the endangered species in Pakistan. As far as SDG alignment is concerned, SDG 15 (Life on Land) is addressed well, SDG 4 (Quality Education) and SDG 13 (Climate Action) are addressed moderately in terms of awareness, but not as action competency, and SDG 12 (Responsible Consumption and Production) is addressed at a very weak level. The 4Rs of Reduce, Reuse and Recycle are mentioned in only one sentence i.e 4Rs strategies of Refuse-reduce-reuse and recycle should be adopted. and not defined, elaborated, provided with examples, student activities and assessment items, which is quite a significant lost pedagogical opportunity. The current study can be useful in enhancing the General Science textbook by introducing more competencies in climate action, enhanced SDG commitment, and significant integration of 3Rs that will make the students become environmentally responsible and action-capable citizens.

Recommendations

1. Climate stories local to Pakistan - monsoon disruption, urban air quality, foods to prompt inquiry and associate world climate science with student experiences, may be found in do-you-know boxes
2. Practical exercises, group tasks, and inquiry-based tasks may be included in the middle of it to boost climate action competencies and critical thinking.
3. Some main points of the chapter may be 3Rs and its applicability to the environment, and the questions to be asked during the exercise should be of application level question on the 3Rs to put it a higher position as the intended learning outcome on the curricular level.
4. The student activity may directly construct the climate action competencies in

order to transform the textbook into action-competent learning rather than the information-transmission.

5. 3Rs may be defined, examples of each R should be provided in the context of the everyday life of the Pakistani students and each of the R should be attributed to climate change.

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