



Climate Change in Science Curricula of Jordanian Schools: Aspiration and Reality

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Introduction

Climate change is defined as the long-term shifts in temperatures and weather patterns. These shifts may be natural and occur, for example, through changes in the solar cycle. However, since the 19th century, human activities have been identified as the main cause of climate change. This is mainly due to burning fossil fuels such as coal, oil, and gas.¹ This paper sheds light on the extent to which the concept of climate change is included in the science textbooks for grades four to eight in Jordan respectively. The objective is to enable decision-makers to formulate a comprehensive strategy for developing and improving science curricula for these grades, ensuring the inclusion of detailed topics that show the danger of climate change to Jordan and how to comprehensively adapt and mitigate its impacts.

The paper combines a review of literature on the subject and the findings of an analytical study on a sample of the science textbook² activities for fourth, fifth, sixth, seventh, and eighth-grade students that were in use for the academic year 2021/2022. The paper analyzes the content of the textbook with regards to terms, graphic displays, and exercises that are compatible with the efforts of the National Center for Curriculum Development and the Ministry of Education in updating and developing curricula to raise the level of knowledge on the topic among students.

Why is climate change so significant to the school curriculum?

The textbook is considered an essential reference of scientific material for students. It is also a teaching used by teachers to formulate lesson plans and choose teaching methods that suit students' needs.³ In addition, the age group from 9-12 years (fourth, fifth, and sixth grades) constitutes the stage of mental development, where the ability to innovate begins, and where students supposedly show enthusiasm for education and curiosity for learning.⁴ As for the age group 13-14 years (seventh and ninth grades), research shows it is a phase of the intellectual maturity of most mental faculties. Hence, students should be provided with intellectual and educational resources to develop their mental abilities and capabilities in analysis, reasoning, and skill acquisition during this important age span. It should be noted that the curriculum of the eighth grade is the last in which the student receives the science subject in one book, as the science subject is divided into four books starting from the ninth grade, and for this reason, it was excluded from analysis in this paper.

¹ United Nations, Climate Action, What is climate change. 2021. <https://www.un.org/en/climatechange/what-is-climate-change>

² The study was limited to analyzing the student's book without the exercise book.

³ Nada Odeh Musleh, The Degree to which the Eighth Grade Science Book Content Realizing the Complies of the International Standards for Tests (TIMSS-2019) From the Perspectives of Science Teachers in Amman, Master Thesis, Middle East University, 2020. <https://bit.ly/3i3T7zE>

⁴ Safaa Said Abdel-Hamid, Erik Erikson: Theory of Psychosocial Development, 2017.

Jordan and climate change

Although Jordan has a low impact on global gas emissions,⁵ it faces several environmental repercussions. These include frequent heat waves, irregular rainfall, and reoccurring floods, which make it a country prone to climate change and its environmental consequences. With the effects of climate change being intense, coupled with the water poverty that Jordan suffers from, Jordan ranks as the second poorest country in water resources and the second driest country in the world.⁶ Therefore, a persistent need has emerged to prepare a generation of educated people who are able to find ways to adapt to slow down the speed of climate change impact on ecosystems. Various types of adaptation can be distinguished, including anticipatory adaptation, autonomous adaptation, and planned adaptation,⁷ in addition to facing sustainable development challenges, “development that meets the needs of the present without compromising the ability of future generations to meet their own needs,”⁸ in line with the requirements of the twenty-first century.”

Conforming with the strategic plan of the Jordanian Ministry of Education 2018-2022 to enhance students' thinking skills and build innovative personalities,⁹ it was necessary for science curricula to keep pace with changes and developments in various fields, especially concerning climate change. The latter is critical to all areas of life, whether directly or indirectly. Additionally, the curricula should present this issue through episodic content that guarantees the simplification and understanding of science behind it, and teach students to integrate into their societies and be able to face individual and social environmental problems in creative ways.

The importance of the textbooks and the teaching method

There are various educational methods that may be used to educate students about environmental protection and their responsibility towards mitigating ecological degradation that result from climate change. The ultimate goal is to provide students with skills to analyze and discuss environmental issues, as well as expose them to the ways to mitigate the effects of climate change and adapt to it to ensure the continuity of life and the preservation of future generations' right.

The textbook is deemed the main teaching tool used by the teacher in the classroom, especially in the primary levels, where the students' capabilities are still progressively budding. Whilst the school is considered the official institution that plays a vital role in educating and teaching successive generations about several issues, it also plays a crucial role in giving students a decent upbringing that makes them good citizens towards their country and environment, in addition to other informal education actors.

⁵ Ministry of Environment, Hashemite Kingdom of Jordan, Mitigation of Greenhouse Gas Emissions Educational Bulletin, Enabling Capabilities Project for Preparing the Third National Communications Report on Climate Change, 2022. <https://bit.ly/3hUjW9F>

⁶ Ministry of Environment, The National Climate Change Adaptation Plan of Jordan, 2021. http://www.moenv.gov.jo/ebv4.0/root_storage/ar/eb_list_page/final_draft_nap-2021.pdf.

⁷ Ibid.

⁸ Emas Rachel, The Concept of Sustainable Development: Definition and Defining Principles, Florida International University, 2015. 10.13140/RG.2.2.34980.22404.

⁹ Ministry of Education, Ministry of Education Strategic Plan 2018-2022, 28. https://moe.gov.jo/sites/default/files/esp_english_final.pdf

The science textbook for the eighth grade in Jordan is one in a series of science textbooks concerned with the development of scientific concepts, thinking skills, and problem-solving. It focuses on granting students the largest roles in the learning process. It also integrates the "STEAM" perspective (Science, Technology, Engineering, Arts and Math), through the employment of e-learning technologies and the improvement of work and life skills, and sustainable development as a guiding principle.¹⁰

According to a study aimed at determining the intelligences (Figure 1) that are preferred by eighth-grade students, it was found that they prefer intelligence related to nature. People with natural intelligence have an interest in natural phenomena.¹¹



Figure 1: The multiple intelligences theory diagram¹²

Evolution of science textbook

The student science book for grades four to eight went through many stages of modification and development, the last of which was in June 2021. However, the scientific educational content of science does not only require the inclusion of new topics or the introduction of a special exercise book, but rather that the curricula must take into account complementarity between topics and link them to the global issues, specifically climate change. The content of the book, especially in science, must be subject to continuous development and evaluation, so that it presents content in a way that allows students to discover information, unleash their ideas, stimulate their motivation towards research and thinking in order to keep abreast of all that is new, and involve them in finding solutions to climate change across all levels. Furthermore, school curricula should include certain concepts such as: climate change, adaptation and mitigation, resilience, and environmental education.

¹⁰ Abeer Issa Awad Al-Halhal and Abd Al-Salam Musa Al-Adeili, Content Analysis of the Science Book for the Eighth Grade in Jordan in Light of the STEM Curve Requirements, Master Thesis, 2021.

¹¹ Ahmed Falah Al-Alwan, "Determining the preferred intelligences of fourth and eighth grade students according to the theory of multiple intelligences," Educational Science Studies 37a No. 2 (2010): 454-474.

¹² Al-Jazi Obaid Al-Rashidi, "Theory of intelligences and their use in teaching." Public Authority for Applied Education and Training website, 2021. <https://n9.cl/tj140>

Textbook analysis

The results of the analysis of the student's science textbook of grades fourth to eight showed specific weaknesses. The most important of which is the failure to include a clear definition of the concept of climate change despite addressing related topics, as there is no unit or lesson that touches on the concept in a clear and direct manner that shows its seriousness, whether at the local or global level. The books are also devoid of linkages to major environmental issues, and its impact on natural resources and their sustainability, despite the interest of the educational content as a whole in some topics related to climate change. Some important topics were addressed in the enrichment and expansion section, but it is mostly presented without substantive discussion, or left as homework for students.

The analysis revealed several approaches through which educational topics can be linked to climate change. The results can be summed up as follows:

1. No straightforward definition of climate change

Based on the analysis of the student's science textbook of the grades at hand, the term climate change was mentioned in the second lesson: The Impact of Environmental Changes on the Environmental Systems of the first unit (Figure 2) for the fifth grade only. Reference was made to the effect of climate change on different environmental systems without mentioning the definition of the concept clearly, nor was it mentioned in glossary at the end of the textbook or in the lesson questions. This would have made it easier for the learner to comprehend concepts, understand the implications of scientific texts, and express their opinion clearly based on this understanding.¹³



Figure 2: Enrichment and Expansion - Fifth Grade Science Book - First Semester

2. Meager content on environmental culture, contrary to the directives contained in Education Law No. (3) of 1994 and its amendments

¹³ Sarah Laqd, "Scientific Definitions of Scientific Terms in Textbooks," Journal of the Arabic Language 21, Issue 43 (2018): 230.

Paragraph K of Article (5) of the Education Law No. (3) of 1994 stipulates “the importance of military education and environmental culture so that “the educational system meets the needs of the individual and society and establishes a balance between those needs”. However, the stages¹⁴ of development of the science book and its amendments did not take into account what was stated in the law. This can be attributed to the fact that environmental education specialists were not involved in planning science curricula and writing textbooks.

Environmental education is defined as an educational science aimed at providing learners with educational patterns to increase students' knowledge and awareness about the environment, its problems, and ways to address them, as stated in the law. Therefore, the involvement of specialists in environmental education may help link the educational material with environmental awareness and the daily problems and behaviors of citizens and students.

3. Teachers' lack of knowledge about some environmental concepts mentioned in the textbook

Many studies indicated that there is a general weakness amongst Jordanian teachers in understanding some environmental concepts, which raises concerns about their ability to communicate some concepts related to the environment and climate change.¹⁵ Given the importance of education and awareness of climate change and the resulting environmental problems, the United Nations Framework Convention on Climate Change emphasized in Article (6) that education, training, public awareness, and the development and implementation of educational and training programs have a role in responding to the effects of climate change.¹⁶

The Jordanian Ministry of Education strives to develop curricula and educational performance to keep pace with the ever changing requirements of the age, and to provide the learners with the necessary knowledge to enable them to elevate their society and interact globally. These developments must work in parallel to achieving the necessary level of awareness among teachers regarding climate change and related concepts.

4. Not including pictures related to climate change or environmental issues on the covers of school books

The textbook is one of the most important tools of educating and a reliable source for students to obtain information and answer questions about the topics raised by the textbook.¹⁷ Interestingly, the cover of the pedagogical book is said to have a vital role in introducing it. The graphic elements and layout are also essential in translating the implications that may require a lot of interpretation and description. Research borne out this fact about the density of information that can be

¹⁴ The Hashemite Kingdom of Jordan, Ministry of Education, Education Law No. (3) of 1994 and its amendments, Article (5) Principles of Educational Policy: 6. <https://moe.gov.jo/node/84151>

¹⁵ Ali Al-Shuaili and Ahmed Al-Rabani, “The Level of Awareness about Climate Change among Student and Teachers in Science and Social Studies Majors at the Faculty of Education at Sultan Qaboos University,” The Jordanian Journal of Educational Sciences 6, No. 4 (2010): 271.

¹⁶ United Nations, United Nations Framework Convention on Climate Change, Article 6: Education, Training and Public Awareness, 1992. <https://unfccc.int/resource/docs/convkp/conveng.pdf>

¹⁷ Siham Nimr Omri, Abdullah Muhammad Khataibeh, and Idris Faleh Al-Momani, An Analytical and Evaluation Study of the Science Book for the Fourth Grade in Jordan in Terms of its Readability, Socialism, and the Science Processes Included, PhD Thesis - Yarmouk University 2020.

transmitted through the visual system. The significance of the image in school textbooks is underscored in the textbooks analyzed.¹⁸ Referring to the results of the analysis of the science textbooks for grades four to eight, the covers are devoid of any image that clearly refers to climate change or even its impact or other environmental topics presented in the book. Therefore, there must be an congruence between the content and the cover. This can help in grabbing students' attention and arousing their curiosity to learn and explore the topic more (Figure 3).



Picture 3: The covers of the Jordanian science books from the fourth to the eighth grade

5. Focusing on new concepts in the “Enrichment and Expansion” section

Units in the science textbooks usually include a section called enrichment and expansion that contains introduction of new concepts. This section is an elaboration on the different topics that the unit tackles. The aim is to help students go deeper into the generic content of the textbook. For instance, some indirect applications or life problems are added, which students resort to solving by linking the topics to these scenarios.¹⁹

The importance of this section is evident. It increases students' ability to link new and different concepts and ideas, creating innovative and diverse opinions and ways of thinking, in addition to boosting their ability to understand unprecedented phenomena and rectify them properly. Referring to the science textbooks, we see that they introduce new topics and ideas in the enrichment and expansion section without adequately linking them with what the unit includes. For example, in the science book for the seventh grade- the first semester, the enrichment and expansion section of the fifth unit, environmental areas for the concept of the carbon footprint (Figure 4) and its role in climate change at the global level was addressed without prior clarification of the concept of climate change in a clear and direct way in any previous curriculum. The student at this beginner level is yet to explore these concepts. it makes it difficult for them to link it to other environmental issues, to find relationships of overlap and influence, or to develop proposed

¹⁸ Amira Hassan Al-Ma'moun and Rufaida Mubarak Muhammad Salih, “Standards of the Quality of the Illustration in the Covers of School Books, Arabic Language Books, Primary Stage (First Episode),” *Journal of Human Sciences* 16, Issue 1 (2017): 167.

¹⁹ Dr. Yahya Salah Madi, *Outstanding Students and Developing Thinking Skills in Mathematics*, Amman: Dar Dibono for Publishing and Distribution, 2011: 79.

solutions that match their educational stage. The enrichment and expansion section is often covered at the end of the class, either by directing students to read the topic or as homework that is rarely discussed subsequently in class.



Picture 4: Enrichment and Expansion - Science Book Seventh Grade - Second Term

Recommendations

1. Formation of a specialized committee in which all relevant entities participate: the Ministry of Education, the National Center for Curriculum Development and the Ministry of Environment to develop a comprehensive strategy for developing and improving science curricula for grades four to eight specifically. This committee can:
 - a. Take into account the necessity to develop the curriculum in a comprehensive way, so that it includes the content of the lessons, pictures, exercises and activities.
 - b. Take into account the link between science, technology, engineering and mathematics with environmental concepts, and finding solutions to adapt to the effects of climate change, in partnership with school teachers, education and Ministry staff.
 - c. Reviewing proposed environmental issues in partnership with the Ministry of Environment to ensure the appropriate ratio or local to global focus is ensured.
2. Allocating a section related to climate change for these classes through the e-learning platform of the Ministry of Education, so that environmental issues are also presented using new technologies that develop students' thinking and problem-solving skills.
3. Designing and implementing a training program for the benefit of science teachers to provide them with appropriate pedagogical methods and to explore new approaches, in cooperation with the Queen Rania Academy for Teacher Training.
4. Encouraging schools, through the directorates of the Ministry of Education, to design extracurricular activities in a way that enhances the level of awareness of climate change among students and teachers with a focus on the Jordanian context.

5. Urging non-governmental organizations working in the environmental field to cooperate with schools to raise environmental awareness and its effects on local communities.

Proposals to include concepts of climate change	References to climate change	Educational gap	Semester	Grade
It was possible to mention the danger of climatic changes to it, or to direct the student to search for other reasons that are not mentioned in the book.	The first unit in the enrichment and expansion section included the risk of extinction on page 23 and factors contributing to the injury of sea turtles. ²⁰	The content did not mention the term climate change and its impact in any paragraph, lesson, or even picture.	First semester	Fourth grade
It is possible to add this in the seventh unit in the second lesson about the four seasons on page 33 by explaining the effect of climate change on the succession of the four seasons.		The textbook did not include the term climate change or its impact.	Second semester	
Linking this to the methods of adapting to climate change by finding alternatives to fossil fuels due to their significant impact on global warming and increasing carbon dioxide emissions.	In the eighth unit, the second lesson, in the enrichment and expansion section, on page 55, the student was directed to search for the concept of renewable energy, its forms, and its importance.			

²⁰ Appendix 2 Picture 1: Enrichment and Expansion - Fourth Grade Science Book - First Semester

<p>It is necessary first to explain the term and then address the effects.</p>	<p>The term is not clearly defined either in the glossary at the end of the book or in the lesson questions.</p>	<p>The term climate change was mentioned in the second lesson (the impact of environmental changes on ecosystems, page 18), where it referred to the impact of climate change on different ecosystems.</p>	<p>First semester</p>	<p>Fifth grade</p>
<p>It is possible to add this in Unit 10, Lesson 1: Components of the Earth, page 86, by explaining the impact of human activities on the Earth's mantle and their role in increasing the severity of climate changes.</p>		<p>The term climate change, its impact or its approaches: mitigation and adaptation are not addressed in the curricula content.</p>	<p>Second semester</p>	
	<p>This has not been linked to climate change and ways to mitigate and adapt to its severe effects.</p>	<p>The book presented a clear sequence with easy-to-understand terminology for students, supported by illustrations related to the topic of pollution in Unit Four, Lesson Two, page 103, by addressing the concept of global warming and the effect of the greenhouse, in addition to the role of human activities in pollution of the seas with plastic</p>	<p>First semester</p>	<p>Sixth grade</p>

		waste and air pollution with carbon dioxide.		
There is room to refer to this in Unit Five, Lesson One: Ecosystem Health, with clarification in the section Effects on Ecosystem Health, pages 11 and 12, as well as in Lesson Two: Biomes, factors section affecting community size, page 19.		The content did not address the term climate change, its effects, mitigation and adaptation to its repercussions.	Second semester	
This can be added in Unit 1, Lesson 3: Earth's Resources, page 18, by linking the concept of sustainable development in the book to the Sustainable Development Goals, specifically Goal 13 of climate action.		The term climate change was not mentioned.	First semester	Sever grade
	The concept of adaptation and its types were discussed with reference to the characteristics of living organisms that enable them to survive in their environment in Unit 9 (Lesson Two: Adaptation	No clarification was provided for the term climate change.	Second semester	

	and Extinction, page 95).			
It is possible to mention the danger of climate change on the water system.	The factors affecting the aquatic ecosystem were discussed in (Lesson 1: Environmental Zones, page 116 of Unit 10).			
	The concept of carbon footprint (Unit 10, Enrichment and Expansion Section p.132) and its role in climate change at the global level is explained.	The concept of climate change was not explained clearly and directly in any previous curriculum, and therefore the student at this educational stage is still uninformed about it, which will make it difficult for them to link it to other environmental issues, to find interaction and influence relationships, and to develop proposed solutions that match their educational stage.		
		The content did not address the concept of climate change or any related term such as adaptation and mitigation.	First semester	Eighth grade
		There was no link between the topic of enrichment and expansion, “combined		

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		hydroponics” on page 142, and methods of adaptation to climate change, as this type of agriculture is one of the most important ways to adapt to the impact of climate changes on rainfall rate and the abundance of water allocated for agriculture.	
		The term climate change is not mentioned clearly or linked to one of the topics included in the syllabus.	Second semester



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يتم تنفيذ برنامج جيل 01 من قبل هيئة أجيال السلام بدعم من السفارة الأمريكية في الأردن.