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Gaps in climate health literacy: an analysis of Kosovo's pre-university curricula and textbooks

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Climate change poses significant health risks, making education on mitigation and adaptation essential. Climate Health Literacy (CHL), recognized as vital in the global response to health impacts of climate change, is crucial for equipping individuals with the knowledge and skills needed to manage these challenges. However, CHL's integration into school curricula remains largely unexplored. In Kosovo, climate change is expected to exacerbate existing environmental issues, yet awareness among young people is limited. This study investigates how climate and health topics are incorporated into Kosovo's pre-university curricula and textbooks (ISCED levels 0–3), focusing on how these connections are addressed to promote CHL. In 2024, a content analysis was applied to Kosovo's Core Curricula for Pre-Primary, Primary, Lower Secondary, and Upper Secondary Education (grades 0–12), issued in 2016, along with the Subject Syllabi for each grade, issued in 2018. Additionally, six textbooks identified through our curricula and syllabi review as covering climate and health topics were analyzed using a coding guide, which was developed specifically for this study based on previous research. The findings were then compared to an existing CHL framework to identify areas of alignment and gaps. The analysis found limited coverage focusing on climate and health across grade levels. In grades 0–5, only one curriculum topic related to climate change and health was identified, with no corresponding material in textbooks. Grades 6–9 included two topics, though these lacked exploration of the links between environmental pollution, climate change, and health. The highest integration was in grades 10–12, where four topics provided more in-depth discussion of these issues. Overall, Kosovo's curricula and textbooks do not fully align with CHL recommendations. The limited coverage in early grades and the lack of interconnected content between climate change and health topics suggest areas for improvement. Increasing localized, context-specific content could enhance Climate and Health Literacy among students in Kosovo.

KEYWORDS

climate change literacy, climate change and health, schools, youth, content analysis

1 Introduction

Human activities, such as greenhouse gas emissions from unsustainable energy usage, land-use changes, patterns of lifestyles, consumption, and production, are the primary drivers of global warming (Lee et al., 2023). These emissions are pushing global temperatures dangerously close to exceeding the 1.5°C threshold set by the Paris Agreement. By 2023, annual mean surface temperatures had reached 1.45°C above pre-industrial levels, exacerbating extreme weather events, altering precipitation patterns, and disrupting ecosystems, all of which pose significant threats to human health and livelihoods (Romanello et al., 2024). Climate change has widespread and diverse direct and indirect impacts on human health, including increased mortality and morbidity from extreme weather events, infectious diseases, malnutrition, mental health challenges, and other health risks. Vulnerable populations, such as women, children, and low-income communities, are particularly at risk (Haines et al., 2006; Woodward et al., 2014; Romanello et al., 2022). However, the pervasive and cumulative effects of climate change make everyone vulnerable, necessitating inclusive action to protect all people across different life stages (Etzel et al., 2024). Consequently, researchers and experts have characterized climate change as a human health emergency (Romanello et al., 2022).

Considering the impacts of climate change (CC) and other global challenges, increasing knowledge and gaining necessary skills for addressing them become essential. The 1987 Brundtland report (Brundtland, 1987), prepared by the World Commission on Environment and Development, recognized global warming among other environmental and social challenges that the world was facing, and proposed to address these issues through 'sustainable development'. The role of education was also acknowledged since the 1992 Rio Earth Summit, but it was not until the 1997 Thessaloniki conference (UNESCO, 1997) that implications for education were clearly formulated, and that the term Education for Sustainable Development (ESD) was used. Subsequently, during its 57th session on 20 December 2002 (A/RES/57/254), the United Nations General Assembly proclaimed the UN Decade of Education for Sustainable Development (DESD) 2005–2014, emphasizing the importance of ESD in addressing pressing global challenges (United Nations General Assembly, 2002). ESD involves acquiring knowledge and skills to support economic, environmental, and social sustainability, empowering learners for action and critical thinking toward a sustainable future (Rieckmann, 2017).

Later, in 2009, the UNESCO World Conference on Education for Sustainable Development in Bonn brought global attention more specifically to the role of education in responding to climate change. The Bonn Declaration (UNESCO, 2009) emphasized the importance of integrating climate change education into the broader framework of sustainable development, stating in Article 16(g) that it is crucial to "intensify efforts and initiatives to put climate change education higher on the international agenda, in the framework of the DESD, in the context of UNESCO's strategy for action on climate change, and as a component of UN-wide action." This highlighted the growing recognition of the importance of climate change education within the broader context of sustainable development.

Following the Bonn Declaration, in the second part of DESD, UNESCO launched a flagship initiative specifically focusing on Climate Change Education for Sustainable Development within the ESD section (UNESCO, 2010). UNESCO stipulates that embedding climate change across school curricula at all levels in a holistic approach interconnecting social, economic, and ecological aspects, while tailoring content to specific target groups and contexts, is essential for successful learning and understanding among students (UNESCO, 2014). This idea is associated with the requirement for member states to incorporate education for sustainable development (ESD) and climate change into their national educational programs. Attaining climate literacy remains one of the main goals of ESD to date (UNESCO, 2023).

1.1 Including health in climate literacy

There are emerging attempts to build momentum to shift "climate literacy" to "climate and health literacy" as recent research is increasingly emphasizing the need that health professionals, governments, businesses and the general public proactively address both climate change and its implication for public health (Crimmins et al., 2016; Shaman and Knowlton, 2018; Watts et al., 2019). A broader educational agenda, at all levels, is imperative to teach future leaders regarding the linkage between climate change and health and to contribute to reduced adverse health impacts as existing educational frameworks mostly focus on health professionals or fail to adequately prepare students due to having limited coverage and limited perspective (Tasquier et al., 2014; Shaman and Knowlton, 2018; Limaye et al., 2020).

While integrating climate change and health into medical school curricula has gained traction in the past few years (McDermott-Levy et al., 2019; Neal-Boylan et al., 2019; Shea et al., 2020), the same cannot be said for primary and secondary education. Although not yet widely incorporating climate change and health topics into curricula, primary and secondary schools have the potential to influence beyond the immediate school environment, such as students' homes or communities (Griebler et al., 2017; Turunen et al., 2017). A scoping review conducted by Ramadani et al. (2023), found that very few educational initiatives focusing on climate change and health within school settings were evaluated and it is not known to what extent these topics are actually being taught in schools, suggesting further research is necessary to evaluate the integration and effectiveness of the programs.

In the context of climate change and health education, Limaye et al. (2020) proposed a framework for climate and health literacy, building on principles of climate literacy developed by the US Global Change Research Program to help educators integrate climate science into curricula. According to Limaye et al. (2020) a climate and health literate individual "can recognize direct and indirect linkages between climate change and health, communicate risks, assess data, comprehend uncertainty, and make informed and responsible personal decisions or advocate for broader policies that protect health."

Grabow et al. (2023) built on the CHL framework and provided a blueprint of integrating it among different audiences, including K-12 or pre-university education. Limaye et al. (2020) and Grabow et al. (2023) argue that there are three literacy levels: "Functional" and "Intermediate," which are ideally achieved during pre-university education, and "Advanced" literacy, which is developed throughout higher education. The Functional level, which should be developed up to grade 8 (K-8), includes two categories: "Root Cause" and

"Mechanism." The first category, "Root Cause," focuses on fostering an understanding of fossil fuels, their role in climate change, and their effects on health. The second category, "Mechanism," aims to raise awareness about the processes through which climate change impacts health outcomes. The "Intermediate" level includes "Determinants," "Implications," "Interventions" categories, which should be developed throughout high school (grades 9–12), emphasizing the intrinsic connection between the environment and human health. The "Determinants" category underscores the profound impact of the environment on well-being, while the "Implications" category stresses the critical role of countering climate change to preserve health gains and bridge disparities. "Interventions" category highlights the necessity of proactive measures for both mitigating and adapting to climate change, safeguarding public health, and enhancing resilience. Finally, the third level, "Advanced," which is designed to be included in higher education, comprises two categories: "Evidence" and "Complexity." These categories focus on understanding the complex and evolving impacts of climate change on human health through the analysis of various data and models (Limaye et al., 2020).

This study aims to explore the curricula of Kosovo and determine the extent to which climate change and health impacts are covered. In particular, the "climate health literacy" framework proposed by Limaye et al., focusing on the first two literacy levels, will be used to determine the gaps that need to be addressed to achieve climate health literacy. To align with Kosovo's education system, we included grade 9 in the "Functional" level, as grade 9 is part of lower secondary education, while the "Intermediate" level will focus on grades 10–12.

1.2 Climate change and health challenges in Kosovo

The Western Balkans are increasingly impacted by climate change, with rising temperatures (1.2°C above 1961–1980 averages) and reduced precipitation amplifying extreme weather events (World Bank, 2024). Heat stress, wildfires, flash floods, and landslides are intensifying, posing risks to health, productivity, and infrastructure (IPCC, 2021; World Bank, 2024). Furthermore, Kosovo's vulnerability may be additionally influenced by resource mismanagement, poor infrastructure and lack of policies, which have resulted in exacerbated environmental issues in the past years (UNDP, 2013; KEPA, 2017, 2022).

Climate change significantly impacts public health by influencing morbidity and mortality linked to air pollutants like fine particulate matter (PM2.5) and ozone (O3) or other climate-related risks, especially in Kosovo urban areas. Air pollution, a major environmental health concern in Kosovo, stems largely from electric power plants burning lignite coal, generating 98% of the energy, and high emissions from old cars running on low-quality fuels (Frese et al., 2024; Shala and Dorri, 2021; KEPA, 2022). In 2020, exposure to PM2.5 concentrations above the 2021 WHO AQ guideline of 5 $\mu g/m^3$ in Kosovo was associated with 3,100 premature deaths, 30,400 years of life lost, and 1,706 years of life lost per 100,000 inhabitants (European Environmental Agency, 2022). Fossil fuel burning also emits VOCs (Volatile Organic Compounds) that interact with "Climate Altering Pollutants," such as methane (CH4) and NOx, further aggravating air quality and climate change. In a study assessing VOCs in Kosovo, it was found that around 90% of VOCs, are emitted from automotive fuels, with less than 10% coming from biogenic emissions (Mula et al., 2024). This issue is particularly pronounced in Western Balkans cities, where urban sprawl, exacerbates pollution due to higher numbers of vehicles and increased reliance on private transportation (World Bank, 2024). Urban sprawl compounds these challenges, increasing exposure to climate hazards. In Pristina, Kosovo urban expansion of 38.22% between 2000 and 2018 led to a 1.46°C rise in land surface temperature, worsening the UHI effect due to reduced vegetative cover (Krasniqi and Rapuca, 2024). Although there is no specific data on Kosovo, the World Bank estimates that heat-related deaths will increase by 5–10 percent by 2,100 in Western Balkans (World Bank, 2024). The UHI effect, by increasing temperatures and altering wind patterns, further exacerbates air pollution, such as the formation of ozone, and amplifies the associated health risks in Kosovo (Faberi and Ramadani, 2014; Shi et al., 2023).

Increased temperatures due to climate change also create favorable conditions for the expansion of vector-borne diseases in Kosovo, such as tularemia and Crimean-Congo hemorrhagic fever (Grunow et al., 2012; USAID, 2017). In addition, an increase in food-borne diseases is also evident in neighboring countries, although specific data for Kosovo is limited (USAID, 2017). Apart from these health impacts, the country's healthcare system faces significant challenges in addressing the broader effects of climate change. A study assessing Kosovo's healthcare system reveals it is inadequate to address climate risks, highlighting vulnerabilities in workforce preparedness, system adaptability, infrastructure, technology, and sustainability (Mehmeti Cakuli et al., 2024). Kosovo's hospitals show medium to high levels of unpreparedness for climate hazards, with heatwaves, floods, and droughts posing significant challenges. The health workforce's lack of knowledge and preparedness, along with vulnerabilities in water, sanitation, waste management, and infrastructure, are the most critical concerns across healthcare facilities. Regions such as Peja and Pristina are particularly at risk due to their exposure to floods and the vulnerability of their infrastructure, underscoring the need for the development of both human and technical capacities and comprehensive emergency preparedness plans (Mehmeti Cakuli et al., 2024).

In response to these challenges, the Assembly of the Republic of Kosovo approved its first Law on Climate Change at the beginning of 2024. The law focuses on mitigation, adaptation, and meeting international obligations, while safeguarding the environment, quality of life, and health. Article 32 highlights education, requiring ministries to integrate climate change topics into curricula, research, and training programs across all education levels (Assembly of the Republic of Kosovo, 2024).

1.3 Education system and environmental education in Kosovo

Kosovo's education system, similar to neighboring countries, originated from a structure primarily designed to support political regimes, with the teaching focusing on transmitting certain knowledge while limiting the learner's critical thinking, participation, and interpretation (Sahlberg and Boce, 2010; Hyseni Spahiu, 2013). The system has undergone reforms, with the latest introduced in 2011 (MEST, 2011; Veselaj and Krasniqi, 2014). Unfortunately, the system is still struggling and needs reforms to offer effective education,

TABLE 1 Levels and grades of pre-university education in Kosovo, correspondent ISCED level and respective Core Curricula.

Pre-primary and primary education	Grades 0–5	ISCED 0; ISCED 1	Core curriculum for pre-primary grade and primary education; Subject syllabi (grades 0–5)
Lower secondary education	Grades 6–9	ISCED 2	Core curriculum for lower secondary education; Subject syllabi (grades 6–9)
Upper secondary education	Grades 10–12	ISCED 3	Core curriculum for upper secondary education; Subject syllabi (grades 10–12)

Source: MEST (2011), BMBF (2023), and MESTI (2023b).

especially after Kosovo ranked in the bottom 10 countries, scoring the lowest across all PISA (Programme for International Student Assessment) categories test in 2022 (OECD, 2023).

Kosovo's education system ensures free and compulsory education for children ages 6–15, covering nine grades of primary and lower secondary education, as outlined in the Law on on Pre-university Education (Assembly of the Republic of Kosovo, 2011). In 2023, compulsory education was expanded to include pre-primary education for children aged 5 to 6 (grade 0), as specified in the recent Law on Early Childhood Education (Assembly of the Republic of Kosovo, 2023). Pre-primary education became mandatory starting in the 2024/2025 school year (Assembly of the Republic of Kosovo, 2023). In the 2022/2023 school year, the Gross Enrollment Ratio (GER) for pre-primary education (age 5) was 85.4%. The enrollment rate in primary education was 100.1%, while secondary lower education had a GER of 92.8 and 77.9% in upper secondary education (MESTI, 2023a). Upper secondary education (ISCED 3), which covers grades 10–12 for students aged 15–18, is voluntary and includes two distinct tracks: general (academic) education offered in gymnasiums and vocational education provided by profiled schools (Pusterla, 2020). The percentage of students in vocational schools enrolled in the 2017/2018 school year was 53%, compared to 47% of students enrolled in gymnasiums. Both tracks prepare students for the State Matura exam, a standardized test required for entry into higher education (KEEN, 2019).

Core Curricula are drafted for three levels of formal pre-university education, which outline learning outcomes (LO) for competencies and curriculum areas for each of the three respective levels (see Table 1). While the subject curricula/syllabi[1] entail topics and learning outcomes by subject areas for each grade, starting from preparatory class up to the 12th grade. A topic, within the context of a curriculum, refers to a specific unit of study delineated by the learning outcomes, guiding what students are expected to achieve within that subject area over the course of a grade or school year (MEST, 2011). In this study, we are focusing on topics within each subject and learning outcomes per topic. Formal levels of pre-university education in Kosovo comply with the International Standard Classification of Education (ISCED), compiled by UNESCO. All formal levels of pre-university education are divided into formal sublevels, with designation—Curriculum stages that have specific aims. As such, this study is focused on ISCED 0; ISCED 1; ISCED 2 and ISCED 3 (BMBF, 2023).

Environmental education was explicitly introduced as a cross-curricular theme for the first time in the Kosovo Curriculum Framework (KCF) in 2001 with the assistance of UNICEF Kosovo in devising the curriculum framework (UNICEF Kosovo, 2001; Pupovci, 2002). An analysis of educational materials derived from KCF 2001 found that the integration of environmental topics was lacking throughout primary education level, with biology being the only subject having included such topics marginally. The same study suggested utilizing subjects like civic education and social education to integrate ESD in an overarching manner, offering diverse learning approaches including scientific inquiry and participatory methods in future reforms (Spahiu and Lindemann-Matthies, 2011). Later, in the 2011 reformed curriculum framework, there is a dedicated effort to incorporate ESD. This aligns with global efforts during the UN Decade for Education for Sustainable Development (2005–2014) to enhance sustainability-focused education (Veselaj and Krasniqi, 2014). Veselaj and Krasniqi (2014) compared the "old" (2001) and "new" (2011) frameworks, and assessed the incorporation of ESD throughout curricula with a particular focus on learning strategies. Although significant curricular changes were apparent, notably adopting a competency-based curriculum in 2011, the analysis shows that the learning content and school-based practices were incomplete and tentative. The analysis also found that the ESD traits, such as participatory, collaborative, action-oriented and process-oriented learning (Lozano et al., 2017) were lacking. Both studies fall short in providing a comprehensive picture of the effectiveness of environmental education or ESD, as students' perceptions and knowledge are not evaluated. A survey of the general population on environmental awareness in Kosovo found that 50.5% of respondents had little to no knowledge about potential environmental threats to their own and their family's health (UNDP, 2020). Similarly, although air pollution is one of the biggest environmental issues in Kosovo, a survey with school children revealed limited knowledge regarding the air pollution sources and risks (Shabani Isenaj et al., 2024). Poor understanding of environmental issues may thus be a consequence of inadequate curricular and school emphasis on these topics (Pupovci, 2002).

Although the integration of ESD and environmental education have been examined to a certain extent, there seem to be no studies looking at the inclusion of the climate change topics within the educational curricula in Kosovo. This content analysis intends to fill that gap and assess the inclusion of climate change topics and specifically examine if these topics shed light on its linkages to health. We hope the results will add to the state-of-the-art as well as to inform decision makers on the importance of teaching about such interconnected topics to increase awareness and resilience.

1 Referred to as "curricula" in official MEST documents [36–51] ("Kurrikula lëndore" [subject curricula]), and as "subject syllabi" in the MEST framework [1]. Subject syllabi and curricula are used interchangeably in this paper.

2 Methods

This paper intends to explore the extend of integration of climate change and health education in pre-university education curricula in Kosovo. To ascertain the extent of the integration of climate change and health in Kosovo school curricula, the analysis will be based on:

- the proportion of climate change and health topic(s) in the pre-university education curricula,
- textbook analysis of the topics (identified from the curricula), and
- juxtaposition of the findings against the Climate and Health Literacy (CHL) framework to identify fulfillment/gaps.

Qualitative Content Analysis (QCA) is a mixed methods approach that assigns categories to text qualitatively and analyses category frequencies quantitatively. This flexible method integrates both qualitative depth and quantitative breadth, supporting comprehensive analysis through both inductive and deductive approaches (Hsieh and Shannon, 2005; Zhang and Wildemuth, 2009; Mayring, 2014). In our study, the initial curricula analysis stage was mainly quantitative, as our primary objective was to explore the usage of both inductive and deductive keywords. Subsequently, our textbook analysis was qualitative, where we used a coding guide based on the CHL framework, to identify patterns, themes, or meanings and understand how and where the content fits into the CHL categories. The research process is shown in Figure 1.

2.1 Curricula analysis

Manifest content was mainly examined throughout curricula, which includes using keyword searches, and recording in frequencies such as word counts. The curricula were analyzed predominantly deductively, where we sifted the data with predetermined keywords, retrieved by UNESCO's (2021) global review of curricula to assess the integration of climate change topics. In a first step we recorded frequencies of "climate change cluster" keywords (see Supplementary Table S1) throughout core curricula and subject syllabi. The frequencies of keywords were counted/assessed using MaxQDA 2022. Ultimately, only "climate change" and "global warming" yielded relevant results and were kept for the analysis. Other keywords such as "climate crisis" yielded no results, while terms like "greenhouse" or "carbon" were often used in conjunction with "climate change" or "global warming," or appeared in different contexts unrelated to these main keywords or concepts.

Topics served as units of analysis in determining the proportion of topics covering the linkages of climate change and health, where they were counted and divided by the total topic number in the curricula. Topic counting was done manually, and due to certain complexities and inconsistencies in the curricula, the reported number is an estimate. This approach aligns with Bagoly-Simó's (2013) approach of counting segments/topics to gage ESD implementation. In a similar fashion, counting the proportions of topics that integrate both climate change and health provides a measure of their emphasis

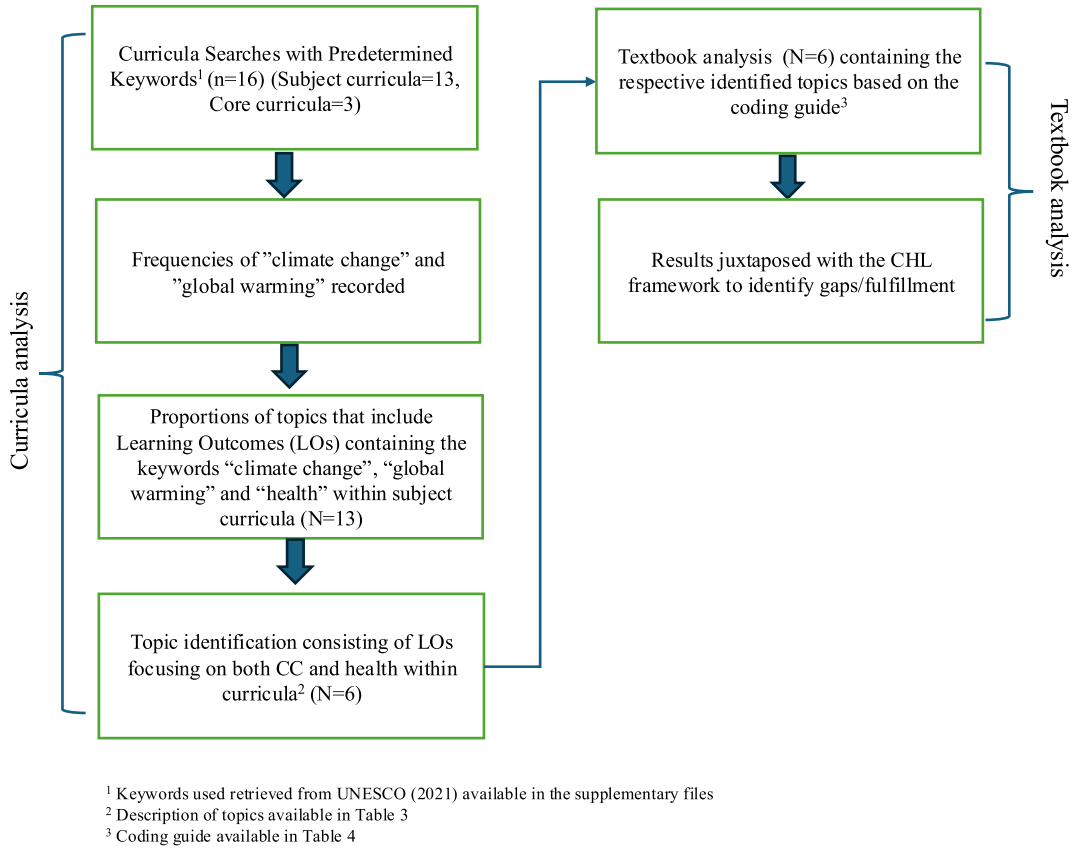

FIGURE 1
Research design and process.

TABLE 2 Total topic number and percentage of climate change and health topics included out of total topics, along with frequency of reference "climate change" and "global warming" within subject curricula and Core Curricula (MEST, 2016b, c, d, 2018a, b, c, d, e, f, g, h, i, j, k, l, m).

Level of education	Grade	Total topic number	Climate change and health topic	Frequency of reference "climate change/global warming"
Pre-primary and primary	Grades 0–5	638	1 (0.16%)	10
Lower secondary education	Grades 6–9	701	2 (0.29%)	15
Upper secondary education	Grades 10–12	745	4 (0.54%)	25
	Total	2,084	7 (0.34%)	50

and integration within the curricula. For a topic to be included in this analysis, its learning outcomes needed to explicitly promote an understanding of the impacts of climate change on human health. Specifically, this required the presence of keywords such as "climate change" or "global warming" alongside "health" or health-related terms emerging inductively. Apart from the keyword "health," we also employed an inductive approach to identify any additional relevant terms that emerged when reviewing the LOs that could signify impacts on health.

2.2 Textbook analysis and CHL framework

After identifying the topics in the curricula that included learning outcomes related to climate change and health, six textbooks containing these topics were retrieved and analyzed. This allowed for getting deeper insights into how these topics are addressed and covered in the textbooks. First, the table of content of the textbooks was reviewed to identify the chapters potentially involving climate change content. This was done monitoring the same keywords used previously for the curricula analysis. However, additional keywords from the environmental cluster, as used in UNESCO (2021), were included to expand the search. The expansion was necessary to avoid overlooking relevant topics that could address climate change within, although not explicitly labeled so.

After identification of relevant chapters, content analysis was guided by a coding framework adapted from previous studies (IPCC, 2014; Adamina et al., 2018; Limaye et al., 2020; Siegmund Space and Education gGmbH and Research Group for Earth Observation, 2021; Cissé et al., 2023; Enke and Budke, 2023; Klüsener and Wittlich, 2023). This guide included categories like climate change causes, mechanisms, health impacts, vulnerabilities/disparities, and mitigation/adaptation strategies. During the content analysis, we examined each textbook to determine whether these elements were not only present but also observed code co-occurrence. For example, we checked if discussions on greenhouse gas emissions (a cause) or altered global temperatures (a mechanism) included references to their effects on health, such as respiratory diseases or heat-related illnesses within the same section. Finally, a narrative description of the inclusion of categories and subcategories, and alignment with CHL categories is given.

2.3 Materials used

Taking into account that ESD is envisaged to be incorporated as a cross curricular topic (MEST, 2016a), all grade and subject syllabi were taken into consideration. Specifically, the Core Curricula for Pre-Primary and Primary, Lower Secondary and Upper Secondary Education in Kosovo (grades 0–5, 6–9, 10–12), along with their Subject Curricula/Syllabi for each grade (0–12) were included for analysis (MEST, 2011, 2016a,b,c,d, 2018a,b,c,d,e,f,g,h,i,j,k,l,m). Most documents were available online on the website of the Ministry of Education, Science, Technology, and Innovation (MEST or MESTI).[2] The missing documents were obtained through contact with the MEST. The latest publications available on the website were retrieved and analyzed, namely, publication from 2016 for the three core curricula and 2018 for subject curricula. All textbooks, core and subject syllabi were available in Albanian only. The native language of the main author is Albanian; thus, the texts were analyzed in Albanian and then the results translated into English. The textbooks analyzed were the latest editions available at the time of the analysis. The workbooks and teacher's book were not included in the analysis, only the main students' textbooks were analyzed. The six textbooks reviewed are: the Society and Environment (2nd grade); Geography (6th and 10th grade), Civic Education (7th grade), Biology (12th grade), and Sociology (12th grade) (see Supplementary Table S3). Although we identified seven topics, only six textbooks were analyzed. We analyzed just one textbook for both the Natural Sciences and Social Sciences in the 10th-grade Geography subject because they share the same learning outcomes and topics.

3 Results

3.1 Curricula analysis

Climate change and health topic integration for grades 0–12 within the curricula was at 0.34%. There was one topic (0.16%) on climate change and health in pre-primary and primary education. In lower Secondary Education the integration was at 0.28%, whereas at Upper Secondary Education, the highest integration of climate change and health topics was present, at 0.54% (Table 2).

Out of all the syllabi curricula (grades 0–12) "climate change" or "global warming" were mentioned 39 times. The distribution of the references varied across grades, with the highest mentions being in grade 10 and grade 12 or Upper Secondary Education, with 8 mentions each. Among all the references analyzed, it was observed that climate change or global warming was specifically linked to health or health-related terms only six times within the LOs of one topic. In one instance (7th-grade Civic Education), although climate change

2 https://masht.rks-gov.net/en/home/

and health are presented in separate topics, we treated it as one and included the textbook in the analysis. This is because the learning outcomes demonstrate their interconnectedness: the first topic discusses the impact of air components and global warming on life processes, while the second focuses on sustainable practices related to water and energy conservation, which influence economic, health, and social well-being (Table 3).

In terms of the Core Curricula, it was noted that the core curricula of grades 10–12 had the highest mentions of climate change/ global health, 7 times. Whereas core curricula grades 6–9 and grades 0–5 had 2 mentions each. In total there were 50 mentions of climate change/global warming across all syllabi curricula and core curricula. The terms "climate change" and "global warming' were used interchangeably across curricula.

3.2 Description of topics and LOs within curricula

In primary and lower secondary education (grades 0–9), there were three topics on climate change and health prevalent in curricula offered in the second, sixth and seventh grade. The first topic was present in grade 2 within the subject "Society and Environment." The second topic is "Human/nature interaction" covered in the subject of Geography in the sixth grade and the third topic is offered within the Civic Education subject in the 7th grade.

In Upper Secondary Education (grade 10–12), there are four topics that address climate change and health within curricula. The four topics are offered in three different subjects Geography, Biology and Sociology. The topics are: "Human/nature interaction," "Environment and Human Health," "Environment and Risk," respectively. These topics are offered in grade 10 and 12, with grade 11 covering no climate change and health topics. The "Human/nature interaction" is prevalent twice in the 10th grade curriculum, with the same LOs being present within Geography for Social Sciences and Natural Sciences. The LOs of this topic were also roughly the same with the ones in the 6th grade.

3.3 Textbook content analysis

The coding guide highlights a substantial focus on anthropogenic causes of climate change, especially in the Biology subject, where human-induced factors dominate over natural causes. There is a notable emphasis on extreme weather and climate systems in Geography and Biology subjects, reflecting concerns about altered hydrological cycles and ocean–atmosphere temperatures. Out of 37 references to the impacts of climate change on climate systems or extreme weather events, 18 (approximately 49%) included a connection to human health. While health impacts of climate change are variably covered, especially in upper secondary education (grades 10–12), mental health is particularly underrepresented.

TABLE 3 Curricula topics, learning outcomes and textbook topic/concept description focusing on climate change and health.

Grade	Subject	Topic	CC and health related learning outcomes (as stated in curricula)[b]
2	Society and environment	Changes in society and nature	Describes the positive and negative changes in life as a result of the development of human society (such as the domestication of animals and birds, the cultivation of the soil, the cultivation of cereals and other local crops, the processing of ores such as iron, copper, etc.; pollution of the environment such as water, soil, air, climate changes, etc.) and the impact of these changes on the quality of human life
6	Geography	Human/nature interaction	Analyses the relationship between man and the environment, such as: the consequences of climate change on the environment and on health, natural and man-made hazards, and ways of sustainable management of natural resources[c]
7	Civic education[c]	The interconnections and mutual influences of nature and society	Evaluates the importance of air components for life processes, as primary industrial materials, and their impact on global warming
		Environment and well-being	Explains the importance and demonstrates skills in water conservation, energy saving, green preservation, waste recycling, plant cultivation, and animal protection, in terms of economic, health, and social well-being
10	Geography (natural sciences/social sciences)[a]	Human/nature interaction	Analyses the relationship between man and the environment, such as: the consequences of climate change on the environment and on health, natural and man-made hazards, and ways of sustainable management of natural resources
12	Biology (natural sciences gymnasium)	Environment and human health	Identifies and researches the primary and secondary sources of air pollution and the consequences for human health from this pollution such as: asthma, emphysema, etc. including diseases related to the effects of global warming
	Sociology (social sciences gymnasium)	Environment and risk	Argues that many environmental issues are related to risk, because they are the result of the expansion of science and technology, such as genetically modified foods, global warming, which has many other consequences, such as floods, the spread of diseases, extreme weather, etc.

[a]Both concentrations share the same topic and learning outcomes, and the analysis was based on a single textbook.
[b]LOs are not exhaustive, only relevant LOs are shown.
[c]The LOs covering climate change and health are presented in two separate topics, but there is a combined treatment in the textbook.

Global health disparities, such as disproportionate impact on certain countries in terms of health is mentioned, with a focus on water access and consequently water-borne diseases, which could be hard to manage for certain countries. In addition, low-income countries are addressed as being more at risk due to already experiencing environmental and social issues. The elderly, children and pregnant women were also identified as being more vulnerable to air pollution.

Practical solutions, such as adaptation and mitigation, are moderately addressed, indicating some focus on actionable climate responses, though the co-benefits of climate mitigation and health-focused adaptation strategies are notably absent. With only one instance of a mitigation measure connected to health. The intersection of environmental and health issues is significantly emphasized in the general and physical health contexts, particularly in Biology and Sociology at the 12th-grade level. Table 4 depicts the coding guide used and the frequencies of mentions of the categories, along with the alignment with the CHL framework.

3.4 Assessment of curricula and textbook content against the CHL framework

According to the Climate Health literacy framework proposed by Limaye et al. (2020) and the analysis of the educational materials, the different categories are partially integrated into Kosovo curricula and textbooks. There are gaps that need to be addressed, to reach full literacy as per Limaye et al.'s framework. The learning outcomes in the curricula and the textbook content touch upon most categories, but in a partial or incomplete manner. For instance, in the first two categories the health impacts are completely missing, whereas in the third category, the coverage of the comprehensive range of health impacts is lacking. Specifically, mental impacts are not mentioned. The two last categories (Implications and Interventions) are providing a fragmented view of climate change impacts by not covering the health co-benefits of climate mitigation and not providing localized examples of health disparities.

3.4.1 Grades 0–9

For the following three categories, three topics/textbooks of three different subjects and levels were taken into consideration: Grade 2- Society and Environment, Grade 6- Geography, Grade 7- Civic Education.

3.4.1.1 Root cause

The learning outcome of Grade 2 states that impacts of climate change on quality of life are elucidated (see Table 3), this seemed not to be the case upon textbook analysis as there was no mention of climate change and/or its impact (Tara-Nixha et al., 2021). In Grade 6 (Bytyqi et al., 2021, pp. 166–167), fossil fuels are covered along with their impact on environmental pollution but no explicit link to health was provided. While, Grade 7 (Krasniqi and Ibrahimaj-Bahtiri, 2020) it is explained how modern life factors, including the use of fossil fuels, exacerbate the climate crisis and negatively impact our health and biodiversity, it does not detail specific health outcomes.

3.4.1.2 Mechanisms

Grade 6 textbook covers climate change impact on the temperature change, hydrological cycle, melting ice caps and glaciers, and sea level rise etc. (Bytyqi et al., 2021, p. 167) but again no explicit linkage to health is provided. While it briefly mentions the economic and societal consequences of heavy rainfall in certain regions, it overlooks the direct and indirect health impacts of climate change. Whereas Grade 7 textbook (Krasniqi and Ibrahimaj-Bahtiri, 2020), also elucidated on the mechanisms of climate change and acknowledges that climatic changes impact human health, but no specific discussion or description of health impacts is present. Although the topic mentions health impacts such as respiratory diseases and cardiovascular stemming from air pollution, it does not link this to climate change (Krasniqi and Ibrahimaj-Bahtiri, 2020). Rather air pollution is attributed to the human-induced changes to nature, such as altering landscapes, reducing green spaces, and increasing pollution.

3.4.2 Grades 10–12

For the following three categories, three textbooks/topics of three different subjects and levels were taken into consideration: Grade 10—Geography, Grade 12—Biology and Sociology.

3.4.2.1 Determinants

In the categories pertaining to upper secondary education, like the lower level, the integration is lacking. In terms to "Determinants" category, it was found that both in grade 10 and 12, the environmental impact, including climate change, on health are addressed. However, the diseases mentioned, as part of these topics, are generally physical such as asthma, transmissible diseases, etc. (Kuçi et al., 2021, pp. 339–340). Mental health is mentioned as being impacted by noise (Kuçi et al., 2021).

3.4.2.2 Implications

This category is partly covered by addressing vulnerability of low-income countries due to environmental, social, and economic factors (Kastrati and Pozhegu, 2019, p. 118), but lacks examples or elaboration how health disparities worsen within these contexts. In the Biology textbook (Kuçi et al., 2021, pp. 323–341) (grade 12), the disproportionate impacts borne by vulnerable populations (pregnant women, elderly people, people with chronic diseases) are elucidated by using air pollution as an example. This section is preceded by elucidation of the linkage between air pollution and global warming. Similarly, the elderly are identified as being at higher risk from secondary pollutants stemming from the reaction of primary pollutant stemming from fossil fuel polluting activities (Kuçi et al., 2021, p. 334). Whereas, the Sociology textbook (grade 12) (Mazreku, 2021), explores the impacts of climate change on human health, with a particular emphasis on water-related issues and the spread of transmissible diseases, which leads to reversal of health gains in certain countries, emphasizing global health disparities.

3.4.2.3 Interventions

Limited information is provided regarding both adaptation and mitigation in terms of climate change and health. In grade 12, one learning outcome seems to elucidate protective behavior by identifying and implementing "measures to protect oneself and others from the effects of environmental pollution." (MEST, 2018b). Whereas, in terms of mitigation, grade 10, a learning outcome is included that stipulates that students explore" strategies for the protection and use of natural resources" (MEST, 2018a, p. 202). These learning outcomes are also present in the textbooks. However, the analysis highlights a deficiency

TABLE 4 Coding categories and coding frequencies.

Categories	Subcategories	Subject and grade						CHL category alignment and co-occurrence
		Society and environment (G.2)	Geography (G. 6)	Civic education (G. 7)	Geography (G.10)	Sociology (G.12)	Biology (G. 12)	
C1.CC causes	C1.1 Anthropogenic causes							Root cause (C1.1)
	C1.2 Natural causes							
C2. CC Impacts on the natural systems	C2.1 Ecosystems							Mechanisms (C2 and C3)
	C2.2 Climate system/extreme weather							
C3. CC impacts on health	C3.1 Conflict/migration/displacement							
	C3.2 General CC impacts on health							
	C3.3 Water security							
	C3.4 Food security and nutrition							
	C3.5 Infectious diseases							
	C3.6 Mental health							
	C3.7 Cardiovascular diseases							
	C3.8 Respiratory diseases							
	C3.9 Injuries and deaths							
	C3.10 Vector-borne diseases							
	C3.11 Heat-related illnesses							
C4. CC Vulnerabilities and disparities	C4.1 Age							Implications (C4)
	C4.2 Gender							
	C4.3 Global health disparities/access to care							
	C4.4 People with pre-existing health conditions							
	C4.5 Socio-economic inequities							
	C4.6 Other vulnerable groups							
C5. Measures	C5.1 Climate adaptation							Interventions (C3 and C5)
	C5.2 Climate mitigation							
C6. Environmental Quality and health	C6.1 General health impacts							Determinants (C6)
	C6.2 Physical health							
	C6.3 Mental health							

Values	No references	0	
	Low (minimal references)	1–3	
	Medium (Moderate references)	4–9	
	High (Frequent references)	10–15	

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in adequately addressing health-focused adaptation measures comprehensively in terms of climate change, beyond protective behaviors against natural disasters (Kastrati and Pozhegu, 2019). Furthermore, the potential health co-benefits arising from mitigation strategies are marginally addressed as they are rather focused on promoting eco-friendly behavior among students (Kuçi et al., 2021, pp. 370–371). Out of all the measures addressed, there was only one instance of a mitigation measure connected to health. Namely, it is stated that waste reduction lowers the impact on the environment, which benefits human health (Kuçi et al., 2021).

Table 5 provides an overview of the integration and fulfillment of the CHL categories in the curricula and respective textbooks of Kosovo.

4 Discussion

Seven out of over 2000 topics comprised learning outcomes related to climate and health in Kosovo's pre-university education curricula. Given the lack of comparative studies this number seems marginal. However, an assessment of the US national science curriculum standard documents found that climate change was mentioned over 30 times but never directly linked to health (Limaye et al., 2020). In addition, compared to previous analysis of environmental topic integration of the preceding curricula before the 2011 reform (Spahiu and Lindemann-Matthies, 2011), more subjects seem to address these topics, expanding beyond Biology. This suggests that there has been an attempt to integrate climate change topics in the 2011 reform.

While the curricula and textbook content covers the effects of fossil fuel combustion on climate change and the consequences for the environment and ecosystems, the implications of climate change on health are often limited. Numerous topics look at the influence of environmental factors on human health, however, the link to climate change is superficial and often unclear. This fragmented approach makes it challenging for students to grasp the holistic view of climate change and health. For example, in grade 6, while the textbook addresses climate change's impact on temperature, hydrological cycles, and melting ice caps, it neglects to link these changes directly to health outcomes such as heat-related illnesses or waterborne diseases. This deficiency persists in higher grades as well, where discussions on environmental pollution primarily focus on physical health issues like asthma, overlooking mental health impacts and the broader spectrum of health effects associated with climate change.

There is also a fragmented presentation of environmental health issues, which highlights a missed opportunity to link it to climate change, indicating the need for a more holistic curricula and textbooks. Such as in the case of grade 7, where air pollution's impacts on health are given but no explicit linkage to climate change was established or how CC could exacerbate these issues. Additionally, vulnerable groups to secondary air pollutants were covered in the Grade 12 Biology (Kuçi et al., 2021, p. 334). This presents a good opportunity to exemplify that the emissions contributing to climate change can also worsen due to climate impacts, leading to compounded risks for human health; for example, ozone formation, particularly in times of intense heat, significantly increases the risks to human health (Hertig et al., 2020).

TABLE 5 Integration of health topics into Kosovo curricula based on CHL categories (Limaye et al., 2020; MESTI, 2023b) and implementation blueprint (Grabow et al., 2023).

Category of CHL (Limaye et al., 2020)	Integration into education levels (Limaye et al., 2020; Grabow et al., 2023)	Climate and health literacy elements (Limaye et al., 2020)	Integration into Kosovo Curricula and textbooks	
			Present	Not present
Root cause	Grades 0–9	The fossil fuels that shape our lives worsen the climate crisis and our health	Fossil fuels and impact on climate change/environment	Explicit link to human health
Mechanism		Climate change affects human health by altering global temperatures, the hydrologic cycle, and driving sea level rise	Climate change impact on environment/ecosystems including altering global temperatures, hydrological cycle and sea level rise	Explicit link to human health
Determinants	Grades 10–12	The environment and our health are intertwined. Quality of life, physical, and mental health are strongly tied to our environment	CC/environmental impacts on physical health and climate sensitive diseases	CC/environmental impacts on mental health
Implications		Climate change can reverse health gains and worsens existing health disparities	Disproportionate impacts on low-income countries and certain vulnerable groups	Localized worsening of health disparities
Interventions		The adverse health impacts of climate change can be reduced through mitigation and adaptation	CC mitigation measures	Health co-benefits of mitigation measures; Climate change and health adaptation

To enhance educational effectiveness, integrating climate change and health more deeply into the educational materials is crucial. Grade 12 Sociology textbooks, for instance, could include specific examples illustrating how climate change exacerbates health disparities and impacts vulnerable populations, particularly in discussions on water-related issues and transmissible diseases. Moreover, addressing the health co-benefits of climate mitigation strategies and promoting adaptive measures beyond disaster preparedness would provide students with a holistic perspective. Bridging these gaps can better prepare students to understand the interconnected challenges of climate change and health, fostering informed decision-making and proactive engagement in sustainable practices. Additionally, incorporating localized case studies or "meeting people where they are" (Grabow et al., 2023) could effectively enhance learning and promote behavior change, aligning with the emerging concept of place-based education in environmental and climate education (Gruenewald and Smith, 2014; Armstrong and Krasny, 2020; Khadka et al., 2021).

4.1 Educational disparities in climate change and health learning outcomes

Disparity between curricula provisions and textbook were also observed during our analysis. The LO in the second-grade curricula stipulates the coverage of "climate change and impact on quality of life"; however, this did not seem to be the case in the textbook. In addition, while the terms "climate change" and "global warming" were brought up 50 times in the curricula spanning from grades 0–12, there seems to be a presence of tokenism in attempts to incorporate ESD. For instance, "global warming" was commonly mentioned within the mathematics section stating that this subject presents a good opportunity to integrate teaching regarding ESD and global warming, among others. However, specific topics and/or learning outcomes within the mathematics subject connected to ESD or global warming were not present. This seems to be consistent with the findings from UNESCO's examination of the incorporation of ESD and climate change topics in member states' policy documents, which found that nearly half of the 100 national curricula examined lacked any references to climate change, and when mentioned, the coverage tended to be superficial (UNESCO, 2021).

The accessibility of essential environmental education varies significantly among students due to specialization within Kosovo's secondary education system. The 12th grade textbook of Biology containing the most topics covering health implications of climate change is only offered to the students who study Natural Sciences, thus students not enrolled in this specialization do not have access to this information. The same applies with the Sociology course, offered to the Social Sciences students. The only exception in this case, is the Geography course that contains the same learning outcomes for both natural sciences and social sciences students. Geography in the 6th grade coincidentally also includes a climate change and health topic in the curricula, which makes this subject as having the most topics and LOs on climate change and health. This is not a surprise as Geography is recognized as a core subject of ESD and climate change due to its thematic alignment with sustainable development and its role in integrating natural and social sciences within curricula (Granados-Sánchez, 2022; Enke and Budke, 2023; Klüsener and Wittlich, 2023).

4.2 Implications for attaining climate health literacy in Kosovo

Notably, there is a greater emphasis on climate change and environmental subjects within the realm of secondary higher education (grades 10–12), whereas these aspects receive less attention in lower grade levels. On top of this the type of information covered depends on the gymnasium specialization in the 12th grade. There are five concentrations offered in Kosovo: Social, General, Natural Sciences, Mathematics-Informatics, and Languages (Pusterla, 2020). The subject syllabi generally offer two versions of lesson plans depending on the overall concentration (Social Sciences and Natural Sciences). This scenario is less than ideal, as incorporating climate change topics across all educational levels would equip students to adeptly tackle forthcoming challenges and requirements (UNESCO, 2014). The latest reformation was implemented in 2011; therefore, the upcoming reformation could benefit from improved integration of knowledge regarding climate and health topics. Especially in the light of a recent study still revealing low environmental knowledge among university students in Kosovo (Ymeri et al., 2023) despite having gone through the reformed and current system of 2011, in which efforts were made to include ESD.

By complementing the existing environmental health topics available in the curricula and textbooks and elaborating the linkages to health impacts, students gain a holistic understanding of the relationship between environment, climate change, and public health.

On top of this, framing climate change impacts in terms of localized health outcomes can be a more effective climate advocacy strategy than solely focusing on environmental concerns (Nemet et al., 2010; Limaye, 2021). Integrating climate change and health education into existing curricula empowers students to recognize risks, advocate for policies protecting both environment and health, and become future proactive climate stewards. While this study focuses on formal pre-university education, it is essential to extend learning opportunities beyond this scope, particularly to disadvantaged groups. Over 20% of youth in Kosovo do not continue their education beyond the compulsory level, and among those who do, access to climate and health topics depends on the specializations they pursue. As noted in the analysis, access to climate and health education varies between Natural and Social Sciences specializations. Additionally, it is unknown to what extent students in vocational schools—who make up over half of upper secondary education enrollments—are exposed to these topics. To address these disparities, climate and health literacy should be integrated across all education levels, including non-formal education. This will ensure that broader community groups are equipped with the knowledge and skills needed to mitigate the impacts of climate change and promote a more equitable approach to health.

4.3 Limitations

There were inconsistencies within the curricula and sometimes difficult to ascertain the exact number of topics. Hence, the topic proportions are an estimation and not an exact number. The implementation gap between the curricula and its representation in textbooks and classroom teaching, must also be taken into consideration. For instance, the 7th-grade textbook integrated climate change and health impacts in some chapters, although these

topics were not explicitly specified in the LOs of the curriculum. Conversely, the 2nd-grade curriculum included LOs on these climate change and impact on quality of life, but they were not mirrored in the textbook. This misalignment suggests that LOs do not always translate into textbook content. Moreover, even if topics are included in the curriculum or textbooks, they may not be adequately taught in classrooms due to various factors. Future research should focus on how well textbooks and teaching practices align with curriculum LOs on climate change and health, and how this alignment can be improved. In addition, didactic analyses could be beneficial to attain a comprehensive view of the instructional effectiveness on these topics.

Another limitation is that our analysis only included textbooks approved by the MEST and accessible to the authors. Other approved textbooks from different publishers, which also align with curricula provisions, were not analyzed. The analysis was also conducted in Albanian and then translated into English, posing a potential risk of losing information or nuances during the translation process, which could affect the integrity of the study's conclusions.

Keyword searching in content analysis presents certain drawbacks. Despite attempts to incorporate a variety of search terms, there's a risk of overlooking pertinent content by excluding alternative terms, certain data may be lost due to translation, and file formatting issues could also lead to relevant keywords being missed. Although the research findings allow for drawing conclusions regarding policy and curriculum documents, additional analyses are required to attain a more comprehensive understanding of how climate change and health topics are incorporated into daily school practices. This entails exploring various teaching approaches, activities, level of knowledge of the teachers, etc.

5 Conclusion

This paper introduces a novel approach to evaluating the inclusion of climate change and health topics in school curricula. Our content analysis of the curricula and textbooks against the climate health literacy framework showed that the curricula fell short in helping the student attain climate health literacy, with all categories being partly fulfilled. Upon examination of the textbooks, disparities and inconsistencies in education were noted, with variations in learning outcomes for different students and minor discrepancies between the curricula and textbooks. Climate change and health topics can be seamlessly integrated into existing curriculum topics tackling environmental health topics, already included as transversal topics, thus providing a holistic overview of the relationships between the environment, climate change, and health. Other suggestions include the integration of localized and contextualized examples that showcase the local impacts of climate change. By examining how climate change and health is incorporated into educational materials, educators and policymakers gain insights into current practices, highlighting effective strategies and areas for improvement.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

LR: Writing – original draft, Writing – review & editing. MB: Writing – review & editing. CK: Writing – review & editing. GS: Writing – review & editing.

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Supplementary material

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