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Changing climates. Representations of climate change in Berlin geography textbooks (1990–2021)

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Changing Climates: Representations of Climate Change in Berlin Geography Textbooks (1990–2021)

Abstract

Dieser Beitrag untersucht den Wandel der Darstellung des Klimawandels in Geographieschulbüchern der Sekundarstufe I in Berlin im Zeitraum von 1990 bis 2021. Mittels einer Inhaltsanalyse erfolgte die Evaluation von vor und nach der Lehrplanreform von 2015 benutzten Schulbüchern. Die Analyse konzentrierte sich auf die acht Kategorien fossile Energieträger, Gletscher, Wälder, Golfstrom, Energieversorgung, tropische Regenwälder, Küstenschutz und Landwirtschaft. Die Ergebnisse zeigen einen Wandel von einer beschreibenden Klimatologie hin zur Darstellung eines zunehmend anthropogen geprägten Klimawandels. Dies geht mit einer Verknüpfung geographischer Inhalte mit einer Bildung für nachhaltige Entwicklung (BNE) sowie einer stärkeren Betonung der Rolle von anthropogenen Einflussfaktoren einher. Anpassungsmaßnahmen an den Klimawandel und physisch-geographische Grundlagen des Klimawandels werden hingegen wenig beleuchtet. Darüber hinaus weisen die nach 2015 benutzten Schulbücher eine alarmistische Sprache auf, die potenziell kontraproduktiv für den Aufbau von Handlungskompetenz sein kann. Die Studie unterstreicht die Notwendigkeit eines ausgewogenen, systemischen Ansatzes im Umgang mit dem Klimawandel und formuliert mögliche (fachdidaktische) Forschungsfragen zu diesem.

Keywords: Geography textbooks, natural climate change, anthropogenic climate change, longitudinal study

1 Climate, school subjects, and adjectival education

Over the last three decades, broad societal discourse on climate and its change experienced a spectacular change. Formal education mirrors, to a certain extent, such societal debates at the prescriptive-normative (i.e., through curricula, textbooks, and teacher education) and the stakeholder level (e.g., students, teachers, parents, publishers, and educational media producers). Although student and youth protests catalyzed the debates around climate change (CC), research in education looks back on considerable history and expertise in addressing societal challenges, in general, and CC, in particular.

Research in education approaches topical aspects, such as CC, in different ways. The history of education, for example, investigates how education reacts to generic societal challenges and changes from a more holistic and broader perspective. In his seminal work on the history of German formal education, Geißler (2023) discusses various trends

and tendencies to reconfigure both the canon of subjects and the very organization of the school and its social interactions. For CC, reform pedagogies and alternative ways of approaching learning play an essential role and explain, to a certain extent, demands and recommendations on navigating the topic both in the classroom and beyond.

Thinking outside the traditional canon of school subjects, even opening the school progressively towards learning in a broader context, lies at the core of environmental movements in education. For decades, climate (and its change) has been part of broader Environmental Education (EE) initiatives deeply rooted in the local field (Filipova, 2021). In Germany, as Hemmer (1998) argues, *Umwelterziehung* (EE in more instructional terms) morphed into *Umweltbildung* (EE), finally leading to *Bildung für nachhaltige Entwicklung* (Education for Sustainable Development, ESD). ESD in itself is a dynamic and highly adaptive field, responding to the demands of contemporary constructivist frameworks based mainly on skills and competencies. Inherently, as Bagoly-Simó (2014) points out, ESD maintains explicit independence from content in both normative documents and educational research. This is surprising, given the claim to implement ESD at all educational levels, in all grades, subjects, and school types (UNESCO, 2007). Furthermore, emerging so called adjectival educations, such as EE, sustainability education, intercultural education, or CC education (e.g., Chang, 2023), are progressively moving into the topical field.

Contrary to the discourse in various adjectival educations, school subjects constitute the main and most efficient platform to address current or future societal challenges, such as CC, in classrooms. In an international comparative study, Bagoly-Simó (2013a) analyzed the contribution of individual school subjects to ESD. Using 46 topics, the study showed the wasted potential of many subjects that regularly work with relevant topics, such as poverty, hunger, protection, demographic change, or CC; however, they do so only in terms of subject-specific knowledge. In contrast, only a few subjects, among which Geography takes the leading role, manage to connect ESD to their subject-specific knowledge.

Traditionally, climate and its change lie at the core of Geography as a school subject. Despite regional differences and particularities in curricular prescriptions, school Geography follows specific approaches. For example, the subject progressively moved away from describing the world along regions to more thematic approaches addressing the human-environment interaction using regional examples. Such shifts required (major) reconfigurations of the content, including the (re)evaluation of its relevance for students. Curriculum studies, on the one hand, help to reconstruct such changes. Klüsener and Wittlich (2023) analyzed 116 German Geography curricula spanning the decades between 1990 and 2020. They found that they featured human effects on the climate as early as the 1990s but only introduced content on climate protection starting in 2004. On the other hand, textbook content mirrors how publishing houses and educational resource producers interpret curricular requirements. For example, a sample of Bavarian Geography textbooks revealed several conceptual inconsistencies across the grades (Bagoly-Simó, 2013b). Focusing on discontinuous text, Schauss et al. (2024) showed that German Geography textbooks mainly used photos, graphics, and diagrams to depict the effects of CC; however, mitigation measures ultimately supporting self-efficacy remained underrepresented. Furthermore, in most countries, additional educational resources entailing lesson plans and various aids complement the textbook content. For the German-speaking countries, several studies explored teaching materials published by commercial textbook and educational media publishers. Focusing on Physical Geography, Bagoly-Simó and Uhlenwinkel (2016) contrasted content dedicated to volcanoes and

climate. The main findings indicate that climate-related content experienced a growing politicization that increasingly detaches itself from the core of geographical knowledge. In a similar study, Reinfried et al. (2018) analyzed teaching materials published between 2006 and 2016 for secondary Geography, Biology, Chemistry, Physics, and Social Studies and found an overall coverage of past and present CC; however, measures for climate protection and climate policy received more limited attention. In addition, some studies address CC within the broader context of resilience (cp. Kriewaldt et al., 2025), navigating uncertainty (Hanke et al., 2022), or the perceived (classroom) challenges of (in-service) teachers (cp. Fögele et al., 2024).

In summary, Geography has a traditional role in discussing climate and its change, both in terms of subject-specific knowledge and ESD. However, there is limited knowledge of how the representation of CC has changed over time. Therefore, this chapter uses lower secondary Geography textbooks for Berlin as a case study to explore how the representation of CC changed over time.

2 Method and sample

Content analysis served to explore how the representation of CC changes over time. A close reading of each textbook helped to identify all spreads dedicated to CC. Following digitization, computer-assisted coding helped to retrieve segments. Subsequent manual processing refined the system of categories. Validation consisted of two steps. On the one hand, additional reading checked for possible oversights in continuous and discontinuous text. On the other hand, a second researcher warranted intercoder reliability (Cohen's Kappa 0.79). A joint coding session targeted the exploration of differences and further adjusted coding rules. In essence, data retrieval and analysis used a combination of automated and in-vivo coding. Given the longitudinal design of this explorative study, a pre-defined set of categories based on, for example, concepts from climatology or the results of previous curriculum and textbook studies, seemed less suitable to detect change in its most diverse forms (including concepts).

The sample consisted of 11 primary and lower secondary Geography textbooks approved in the Federal State of Berlin between 1990 and 2021. There are two main reasons why Berlin constitutes a unique case study. On the one hand, unlike in the rest of Germany, primary education in Berlin and Brandenburg encompasses six instead of four years. Until 2015, Geography was an independent school subject in grades 5–6; however, the last curricular reform introduced a new compound subject called Social Studies. Consequently, Geography lost two years in the curriculum, which is assumed also to impact representations of CC. On the other hand, following German reunification, Berlin is the only federal state where the educational systems of former West Berlin and the German Democratic Republic (GDR) had to be further developed into a joint structure. The latter aspect also impacted the decision only to consider the decades following German reunification, namely the assumption that potentially different perspectives may have developed compared to previous findings carried out mainly in other federal states of the former Federal Republic of Germany. Finally, upper secondary Geography remained unconsidered as it is an elective subject at an educational level that is not mandatory. Based on the aforementioned impact of the 2015 curricular reform, the sample consists of two subsamples, namely the first containing both primary and lower secondary Geography textbooks used between 1990 and 2015 ($n = 5$) and the second subsample consisting of lower secondary Geography textbooks in use between 2016 and 2021 ($n = 6$). For improved legibility,

the subsequent sections use acronyms for the textbooks (i.e., TB A-K). The complete list of the textbooks is included in a separate subsection of the references at the end of this contribution.

3 Results

The main findings are introduced after the two subsamples. For each subsample, a brief overview of the curricular prescriptions provides context before the results of the textbook analysis are presented.

3.1 Representations prior to the curricular reform

The first subsample covers the time between German reunification and the second major curricular reform (2015), significantly reducing Geography's curriculum space.

3.1.1 Curricular frameworks

Several provisional curricula were in place in the Federal State of Berlin following German reunification, with the first fundamental post-socialist reform in 2006 (SBJW, 2006). Primary and lower secondary education experienced a second curricular reform in 2015 (SBJW, 2015; see also Bagoly-Simó, 2024). Prior to 2015, primary and lower secondary Geography curricula followed a regional-thematic approach primarily consisting of content dedicated to continents. Such regional units addressed different topics, among others, weather and climate. Consequently, climate constituted a rather dispersed topic across several regional units; however, mandatory curricular prescriptions did not include CC.

3.1.2 Textbooks

The 2,946 segments retrieved from the first subsample cover a broad topical range. Based on both subsamples, eight main categories, namely *fossil fuels*, *glaciers*, *forests*, *Gulf Stream*, *energy supply*, *tropical rain forests*, *coastal protection*, and *agriculture*, were further considered for this study (see Table 1).

Tab. 1: Comparative categories prior to 2015 (own research)

Category	Implicit	Explicit	Mitigation	Textbook(s)
<i>Fossil fuels</i>	✓			B, C, D, E
<i>Glaciers</i>				A, B, C, D, E
<i>Forests</i>	✓	✓	✓	B, C, D, E
<i>Gulf Stream</i>				A, B, C, D, E
<i>Energy supply</i>		✓	✓	D
<i>Tropical rain forest</i>		✓		E
<i>Coastal protection</i>		✓	✓	B, C
<i>Agriculture</i>	✓	✓	✓	A, B, C, D, E

Considering their *breadth*, the categories achieved different coverage. All categories were represented in at least two (coastal protection) or four (fossil fuels, forests) textbooks except for energy supply and tropical rain forests. All five textbooks of the first subsample contained segments belonging to the categories of glaciers, Gulf Stream, and agriculture.

Similarly, the textbooks tie the categories to a varying extent to CC. An equal number of topics addressed CC in the most exhaustive manner (i.e., implicit, explicit, mitigation) – agriculture and forests – or remained disconnected entirely from the topic (glaciers, Gulf Stream). The remaining topics reflected various approaches, ranging from implicit (fossil fuels) or explicit ties (tropical rain forest) to a combination of explicit mentioning and mitigation (energy supply and coastal protection).

When viewed jointly, the representational breadth and the contribution to CC display a specific distribution. Two of the three most broadly represented categories (glaciers, Gulf Stream) left CC unconsidered. At the same time, the topics of agriculture and forests reached (almost) maximum coverage, concurrently establishing complete links to CC.

The *explicit* ties established with CC tend to either focus on one geosphere or connect at least two. The former remains limited to the changes in the atmosphere's composition, particularly concerning the greenhouse gas CO₂. The latter addresses the effects of sea-level rise in coastal areas (hydrosphere <-> lithosphere), dying forests due to acid rain (biosphere <-> atmosphere), or deteriorating soil and groundwater quality due to nutrients used in agriculture (hydrosphere <-> lithosphere). Nonetheless, only TB D mentions CC explicitly. The *implicit* links cover a variety of topical areas ranging from changes in land surface use to alternative ways of managing resources (e.g., conventional vs. ecological agriculture). The *mitigation* strategies remain descriptive without mentioning the concepts of sustainability or sustainable development. Instead, they remain deeply rooted in the protection discourse:

„Mit der Bedrohung des Klimas durch die Freisetzung von Treibhausgasen wie dem Kohlendioxid muss die Energienutzung auch immer unter dem Gesichtspunkt des Umweltschutzes betrachtet werden“ (TB D, p. 110).

[With the threat to the climate posed by the release of greenhouse gases, such as carbon dioxide, energy use must always be considered from the point of view of environmental protection.]

Some of the mitigations featured in the textbooks are reforestation, saving energy, pursuing solar energy, dyke construction, or using renewables.

3.2 Representations following the curricular reform

The second subsample entails textbooks used after the 2015 curricular reform in lower secondary education. Textbooks for the newly introduced subject of Social Studies remained unconsidered.

3.2.1 Curricular Frameworks

The last reform of lower secondary education in Berlin took place in 2015. Geography experienced a fundamental change, as a thematic approach replaced the previous regional-thematic approach. Instead of focusing on continents, the newly defined units concentrate on topics. One of the four mandatory topics is “3.6 Klimawandel und Klimaschutz als Beispiel für internationale Konflikte und Konfliktlösungen 9/10” [CC and climate

protection as an example of international conflicts and conflict resolution] (SBJW, 2015, p. 26; see Table 2). Along with a broader context, the curriculum prescribes, on the one hand, mandatory content. On the other hand, it suggests possible concretizations to the mandatory content; however, teachers are broadly independent in choosing their topical and regional examples.

Tab. 2: CC in the 2015 lower secondary Geography curriculum (SBJW, 2015, p. 26; amended and translated by the authors)

CC and climate protection as an example of international conflicts and conflict resolution	
<ul style="list-style-type: none"> • CC is an issue that is highly relevant and attracts intensive media attention. • Suitable climate protection measures are the subject of heated debates at local, national, and international scales. This often involves conflicts of interest. • The topic can be examined geographically in terms of the variety of potential consequences and measures in various regions of the planet. 	
Mandatory Content <ul style="list-style-type: none"> • Causes and regional/global consequences of CC • Sustainable measures for climate protection • Conflicts of interest in climate protection 	Possible Concretization <ul style="list-style-type: none"> • Weather and climate • Structure and composition of the atmosphere • Greenhouse effect • Climate protection and sustainability, adapting to CC • Depiction of CC in the media (e.g., weather phenomena/polar bears as symbols of CC)

3.2.2 Textbooks

The second subsample contained 3,050 segments. Based on both subsamples, eight main categories, namely *fossil fuels*, *glaciers*, *forests*, *Gulf Stream*, *energy supply*, *tropical rain forests*, *coastal protection*, and *agriculture* were further considered for this study (see Table 3).

Tab. 3: Comparative categories after 2015 (own research)

Category	Implicit	Explicit	Mitigation	Textbook(s)
<i>Fossil fuels</i>		✓		G, I, J
<i>Glaciers</i>		✓		H, K
<i>Forests</i>		✓		F, H, I, J
<i>Gulf Stream</i>	✓	✓		F, J
<i>Energy supply</i>		✓	✓	G
<i>Tropical rain forest</i>	✓	✓	✓	G, J, K
<i>Coastal protection</i>	✓	✓		G, H, I, J
<i>Agriculture</i>		✓		G, H

The topics achieved heterogeneous *coverage*. Overall, each topic was represented in at least one textbook, but none reached full coverage across the subsample. Except for energy supply, all topics were counted in at least two (glaciers, Gulf Stream, and agriculture), three (fossil fuels, tropical rain forest), or four textbooks (forests).

Regarding their *links to CC*, all textbooks of the subsample established explicit ties. Furthermore, three additional topics, namely Gulf Stream, tropical rain forest, and coastal protection, also made implicit links to CC. However, the textbooks only covered mitigation for energy supply and tropical rain forests.

The interplay of representational breadth and ties to CC shows that topics combining explicit links with implicit ones and/or mitigation only reach up to three textbooks, except for coastal protection. *Explicit* ties typically connect two or more geospheres. For example, the topics forests and tropical rain forests establish the biosphere <-> atmosphere <-> hydrosphere link, while coastal protections stresses the ties along the biosphere <-> lithosphere <-> hydrosphere chain. Still, two topics remain within a sole geosphere: the atmosphere (fossil fuels) and the hydrosphere (Gulf Stream, glaciers). Furthermore, several topics also connect with human societies, as with energy or agriculture. The textbooks also explicitly mention the concepts of CC and sustainability.

The textbooks suggest various ways to mitigate the effects of CC, such as reducing each individual's energy consumption, switching to renewable energy, and using the online search engine Ecosia to protect the tropical rain forest.

Finally, the second subsample also features a range of concepts that put CC into a rather negative spotlight. Such concepts are climate catastrophe (*Klimakatastrophe*), climate crisis (*Klimakrise*), climate collapse (*Klimakollaps*), climate problem (*Klimaproblem*), and climate risk (*Klimarisiko*).

4 Discussion

The results of this study showcase a fundamental change in the representation of CC in lower secondary Geography textbooks used before and after the 2015 curriculum reform. There seem to be six main layers to this change.

First, the categories of the two subsamples show a remarkable shift from climate as a geosphere of the human-environment system to CC. Instead of a descriptive climatology, (human-induced) change constitutes its new core. This raises fundamental questions concerning how climatological content could and should be structured to maintain systemic ties with other human and physical elements of the human-environment system. Concurrently, navigating additional content, such as meteorology or climate zones, also requires further attention.

Second, the findings point to Geography's increasing commitment to ESD. On the one hand, they confirm the results of previous studies that diagnosed geography's strong thematic and conceptual affinity for ESD (Bagoly-Simó, 2013a). On the other hand, Geography shows, using the topic CC, how to link ESD to subject-specific knowledge. The eight heterogeneous categories showcase how textbook authors establish ties between ESD and a growing number of topics relevant to CC.

Third, and this follows from the previous point, the Berlin case study shows that (progressively) emphasizing a geographical understanding based on systems can benefit ESD and, ultimately, learning about CC. Following the 2015 reform, the topics increasingly interlink various geospheres, offering a more holistic and systemic view of the human-environment interaction. While this is a welcome development to strengthen physical-geographical content (Bagoly-Simó, 2024), it raises concerns about the depth of knowledge tied to the individual topics. As a rather horizontal discipline, Geography is better advised to keep its depth wherever possible and (re-)evaluate the need to increase horizontal ties and connections further.

Fourth, over time, there is a growing emphasis on the role of the human factor in CC. However, two main challenges emerge from this shift. On the one hand, the links are exemplary, insular, and somewhat arbitrary. The concepts of space and scale – preferably tied to regional geographic content – could offer a valuable tool for comprehensive and holistic ties between various facets of human societies and their ties with the physical environment. On the other hand, addressing the role of humans in CC seems to be accompanied by a decrease in the level of detailedness of the physical environment (i.e., how well basic concepts and processes related to climate are explained).

Fifth, mitigation remains a weakness of most textbooks. However, the evidence shows a discourse stuck in protectionist debates of EE (Hemmer, 1998) instead of building agency by showing positive examples and success stories. For example, it is striking that the textbooks stopped mentioning the reduction of freon (Montréal Convention), leading to an overall ozone layer recovery.

Finally, the alarmistic language used in several textbooks used after 2015 seems counterproductive for agency-building and goes against the Beutelsbacher consensus prohibiting overwhelming the student. The repeated use of the terms record forest fires (*Rekordwaldbrand*), extreme weather (*Extremwetter*), extreme temperatures (*Extremtemperaturen*), extreme weather (*Wetterextrem*), record heat (*Hitze-/Wärmerekord*) often paired with a religious connotation (i.e., climate sinners – *Klimasünder*) ignites further despair, sense of helplessness, and paralyzing fear, as vividly showcased by youth movements and articulated by young people involved in such actions.

5 Conclusion

This chapter aimed to explore how representations of CC changed over time. The particular case study of lower secondary Geography textbooks in the federal state of Berlin showed significant change targeting both the conceptual structure of content tied to CC and its links to ESD. Still, readers need to be mindful of the many limitations of this study. First, Berlin stands for a unique case study. Future studies need to take a more comprehensive approach to shed better light on Geography (and other subjects) in Germany's federal education system and beyond by taking an international comparative perspective. Second, a significantly more extended period is required to draw substantial conclusions on how German schools, on both sides of the Wall, navigated climate and its change. Third, a more systematic sampling, for example, considering all textbooks by a specific publisher, could offer better insight into topical coherency across grades. Fourth, there is a need to contrast climate with other topics. For example, previous studies (Bagoly-Simó & Uhlenwinkel, 2016; Reinfried et al., 2018) uncovered highly specific trends regarding C(C) when compared to geomorphology. Fifth, despite lower secondary education constituting the last mandatory stage of formal education, it would be useful to expand the scope of the analysis to both upper secondary and primary education. The latter may include Geography as content incorporated into compound subjects, such as Social Studies – yet another challenge to be explored. Finally, stakeholder studies could shed light on the specifics of teaching and learning in classrooms and beyond. Textbook studies only consider possibilities; classroom realities may strongly differ from textbook content. Looking beyond its limitations, the findings of this study raise a range of important questions for Geography as a school subject and for CC as a central topical area of formal education. Some of these are the impact of the curricular reform replacing the regional approach with a thematic one, the exploration of change experienced by (networks of) concepts over time, or the contribution of such changes to geographical knowledge. These and other questions should be explored in future studies to understand better teaching and learning about CC.

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