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What Does That Have to Do with Geology? The Anthropocene in School Geographies around the World

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Based on the growing body of research and vivid scientific discourse, the Anthropocene is slowly making its way into the curricula of geography programs across the world. Unlike academic geography, the school subject seems to be more reluctant when it comes to the Anthropocene's implicit implementation. Using content analysis, this article explores how geography curricula or compound subjects containing geography for lower secondary education in fifty countries represented the Anthropocene. The results showed that most curricula detached the Anthropocene from geological time and focused, in a disconnected manner, on three of its descriptors, namely, population growth, industrialization, and globalization. Greenhouse gases played a subordinate role. Also, most curricula operated at the national or global scale, leaving little room to navigate processes on several scales. The results also revealed few differences between curricula prescribing geography as an independent subject or as part of compound subjects, such as social studies or social sciences. *Key Words: Anthropocene, comparative study, curriculum, education for sustainable development, geographical knowledge.*

In his seminal paper “Geology of Mankind,” Crutzen (2002, 23), reinforcing the initial ideas of Crutzen and Stoermer (2019), attributed the concept “‘Anthropocene’ to the present, in many ways human-dominated, geological epoch, supplementing the Holocene—the warm period of the past 10–12 millennia.” Taking on these thoughts, the International Commission on Stratigraphy’s Anthropocene Working Group voted in favor of treating the Anthropocene as a formal chrono-stratigraphic unit based on stratigraphic signals originating from as early as the mid-twentieth century (Anthropocene Working Group 2019).

Despite the modest chances for its addition to the Geological Time Scale soon, in a synoptic triptych, Castree (2014a, 2014b, 2014c) examined the potential of the buzzword Anthropocene to mature into a keyword of great societal importance. Looking beyond the conceptual framework offered by Earth system science and the planetary boundaries concept, Castree (2014c) sketched the role of geography, a broad discipline dedicated to human-not-human-relationships, in exploring “the full spectrum of problem definitions and suggested responses reflective of human disagreements about the right way to live on Earth” (474).

Indeed, finding responses to the right way(s) to live on Earth has been at the heart of geography both as an academic discipline and as a school subject. As the International Charter on Geographical Education (IGU-CGE 2016) states, in schools, geography provides the knowledge to “live sustainably in this world [and to] understand human relationships and their responsibilities to both the natural environment and to others” (5). Nevertheless, how far are we down this road? What are the curricular prescriptions of the school subject of geography around the world concerning the Anthropocene? This article aims to explore how fifty geography curricula for lower secondary education discuss the Anthropocene. Following a brief discussion of curricular research in geography education, the article describes the methods and sample, proceeds to present the results and their discussion, and closes by formulating some conclusions.

Geography Curricula and (Education for) Sustainable Development

For geography as a school subject, “the right way to live on Earth” (Castree 2014c, 474) has traditionally

been connected to environmental education and, later on, education for sustainable development (ESD; Bagoly-Simó 2014). Signed in Lucerne, the International Declaration on Geographic Education for Sustainable Development (Haubrich, Reinfried, and Schleicher 2007) reinforced the role geography plays in formal education in shaping a more sustainable future.

Following the Lucerne Declaration's ratification, Lidstone and Stoltman (2007) identified the need for more comparative research on how geography curricula addressed ESD. A decade later, Chang and Kidman (2018) concluded that "we are still awaiting this research," although, "what we do have are a loose collection of anecdotes and examples on practices across Higher Educational Institutes and from K-12 contexts" (281). In general terms, this diagnosis might be accurate. As early as 2014, however, Bagoly-Simó (2014) published in the same journal a comparative curricular analysis of Bavarian, Mexican, and Romanian geography curricula and found a broad and deep implementation of both the concept of sustainable development (SD) and ESD-relevant topics. In a larger project, the author compared all subjects included in the curriculum of the three countries, measuring the topic-based implementation of ESD into lower secondary education (Bagoly-Simó 2013, 2014). The evidence showed that geography, closely followed by biology and technology, exhibited the broadest and deepest implementation of ESD topics in all three countries (Bagoly-Simó 2013, 2014).

Geography's contribution to ESD rests on both its conceptual affinity with SD and the intimate ties between geographical knowledge and ESD topics (Bagoly-Simó 2014). In most countries, geography reflects on human-environment interactions from multiple perspectives, such as ecologic, economic, social, cultural, and political ones. Also, the school subject emphasizes scale as one of its central concepts that enables the exploration of intragenerational or global equity from the local to the global. In addition to its conceptual affinity with the three poles of SD and the matter of generational equity (Bagoly-Simó 2014), geography connects ESD to its subject-specific knowledge through ESD topics (e.g., hunger, water, climate change, demographic development, consumption, waste, biodiversity) rather than implementing ESD as an add-on.

Large-scale international comparative work on geography curricula, particularly concerning ESD,

and, implicitly, the issue of how to negotiate the right ways to live on the planet, have remained an open issue. This article aims to explore how fifty geography curricula for lower secondary education discuss the Anthropocene as one specific facet of the subject's contribution to a much broader ESD.

Method and Sample

Content analysis served to analyze the representation of the Anthropocene based on nine predefined categories (see Table 1) derived from the definitions of the Anthropocene by Crutzen (2002), Crutzen and Stoermer (2019), and the Anthropocene Working Group (2019). The first category targeted all segments entailing the Anthropocene's explicit mentioning and aimed at uncovering its direct implementation in the individual curricula. The remaining eight categories covered various facets of the Anthropocene concept and enabled it to explore its implicit implementation in the curricular documents. The second category (*geological time*) addresses together with the third category (*golden spike*) the claim to formalize the Anthropocene as a unit within the Geological Time Scale via a global boundary stratotype section and point, or golden spike. Both categories originate from Crutzen's (2002) definition and also constitute the core of the Anthropocene Working Group's (2019) argument to formally end the Meghalayan Age of the Holocene and replace it with the human-dominated Anthropocene. Categories 4 through 6 (*population growth*, *industrialization*, and *globalization*) stand for the geological proxy signals accumulated within recent geological strata that describe the unprecedented impact humans had on the planet. All three processes continue to shape the strata and, consequently, record the impact of societies on the Earth, the reason why the Anthropocene Working Group (2019) selected them as proxies for the age of Great Acceleration. *Artificial radionuclides*, the seventh category, represented the Anthropocene's primary marker at the global scale due to the thermonuclear bomb tests of the 1950s. As the Anthropocene Working Group (2019) argued, the thermonuclear tests carried out with artificial radionuclides left the sharpest and globally most synchronous effect in the geological strata marking the beginning of the Anthropocene. The last two categories, namely *carbon dioxide* and *greenhouse gases*, are other

Table 1. Definition and source of the predefined empirical categories

Category no.	Category name	Source	Definition
1	Anthropocene	Crutzen (2002, 23)	The present, in many ways human-dominated, geological epoch, supplementing the Holocene—the warm period of the past 10–12 millennia.
2	Geological time	Anthropocene Working Group (2019)	The place of the Anthropocene in the Geological Time Scale at series/epoch level (its base/beginning would terminate the Holocene Series/Epoch as well as the Meghalayan Stage/Age).
3	Golden spike	Anthropocene Working Group (2019)	The place of the Anthropocene in the Geological Time Scale defined by the standard means for a unit of the Geological Time Scale, colloquially known as a golden spike.
4	Population growth	Anthropocene Working Group (2019)	Geological proxy signals preserved within recently accumulated strata resulting from the Great Acceleration of population growth placing the beginning of the Anthropocene in the mid-twentieth century.
5	Industrialization	Anthropocene Working Group (2019)	Geological proxy signals preserved within recently accumulated strata resulting from the Great Acceleration of industrialization placing the beginning of the Anthropocene in the mid-twentieth century.
6	Globalization	Anthropocene Working Group (2019)	Geological proxy signals preserved within recently accumulated strata resulting from the Great Acceleration of globalization placing the beginning of the Anthropocene in the mid-twentieth century.
7	Artificial radionuclides	Anthropocene Working Group (2019)	The sharpest and most globally synchronous signal forming a primary marker is made by the artificial radionuclides spread worldwide by the thermonuclear bomb tests from the early 1950s.
8	Carbon dioxide	Crutzen (2002); Crutzen and Stoermer (2019)	Atmospheric and stratigraphic proxy signal of the Anthropocene resulting from the increasing carbon dioxide emission over the course of the twentieth century and ongoing.
9	Greenhouse gases	Crutzen (2002); Crutzen and Stoermer (2019)	Atmospheric and stratigraphic proxy signal of the Anthropocene resulting from the increasing greenhouse gas (other than carbon dioxide) emissions over the course of the twentieth century and ongoing.

atmospheric and stratigraphic proxy signals of the Anthropocene (Crutzen 2002; Crutzen and Stoermer 2019).

Four main reasons support the conceptualization of the Anthropocene, along with the nine previously described categories. First, Crutzen's (2002), as well as Crutzen and Stoermer's (2019) definition, despite various (re)conceptualizations resulting from the growing interest across a multitude of disciplines, continues to represent the most influential conceptual framework for the Anthropocene. Second, the arguments put forward by the Anthropocene

Working Group (2019) both synthesize the magnitude of the human impact on the planet and claim, based on their impact, the formal inclusion of the Anthropocene in the Geological Time Scale. Third, the emphasis on human–environment interaction in general and human impact on the planet, in particular, lies at the heart of geography as a school subject (IGU-CGE 2016) and stands for its contribution to ESD (Haubrich, Reinfried, and Schleicher 2007). Fourth, the nine categories operationalize the explicit and implicit implementation of the Anthropocene concept into geography curricula.

The first analytical step consisted of software-assisted (MAXQDA) lexical retrieval of all segments entailing the predefined categories. Thereby, segment retrieval rested on both truncated concepts and their synonyms, in each of the eight languages represented in the sample. During the second step, the qualitative analysis of each retrieved segment led to semantic disambiguation. Finally, document mapping served to analyze each segment's position in the curricular document concerning those coded in the nine categories, revealing both their clusters and dispersal representations. During this step, the analytical process focused on both the number and relative position of segments belonging to the nine categories to diagnose the Anthropocene's specific conceptualization in the curricular document. For example, balanced conceptualizations rested on several proxies (categories 4–9) of similar importance located in relative proximity within the curricular document. In contrast, unbalanced conceptualizations reflected a unilateral emphasis on one or only a few proxies scattered across the various elements of the curricular architecture. In addition, the analysis of document maps enabled the distinction of curricula that featured (some of) the categories as part of their mandatory or elective content. Document maps also allowed us to analyze the relative position of segments representing the individual categories within the curricular architecture and disclosed information on the Anthropocene's implementation as part of, for example, skills, competencies, content, suggested learning activities, or assessment.

The sample consisted of fifty-two national or state lower secondary geography curricula representing fifty countries. Curricula Worldwide, the international curriculum database of the Georg Eckert Institute for International Textbook Research (<https://curricula-workstation.edumeres.net/en/curricula/>), served to identify geography curricula for lower secondary education available online or in the institute's library. In addition to geography as an independent school subject, the database considered all compound subjects that geography was part of (e.g., social studies, social science). In the last step, the sample constitution considered all curricula accessible to the author in the following languages: English, French, German, Hungarian, Italian, Portuguese, Romanian, and Spanish. Also, a final selective step targeted the broadest global

distribution. In the case of countries with federal educational systems, curricula selection followed national particularities. The curricula of the provinces of Ontario (largest in terms of [English-speaking] population) and Québec (largest community of French Canadians) represented Canada. North Rhine–Westphalia (largest population) and Berlin/Brandenburg (joint curriculum of a former socialist region and one of the three city-states of the country) represented Germany, following the usual sampling of federal educational systems. The final sample contained twenty-one geography curricula and twenty-nine curricula of compound subjects with geographical elements (see Appendix).

Results

Semantic disambiguation identified 558 of the 3,327 initially retrieved segments that contain five of the nine predefined categories. The distribution of the segments (Table 2) showed an emphasis on population growth, followed by globalization and industrialization. Although the curricula of the Canadian provinces entailed five and the Liechtenstein curriculum four categories, 16 percent of the fifty curricula contained three, one third two, one quarter one, and one fifth none of the nine categories.

Except for the Canadian curricula, document mapping showed a dispersed distribution of the five identified categories constituting a thematic island within the curricular documents.

The concept of the Anthropocene was missing from the analyzed curricula. The eight categories derived from its definitions, however, showed different patterns, as described next.

Geological Time and Stratigraphy

A total of two of the fifty analyzed curricula mentioned geological time. In Moldova, the curriculum required students to apply their knowledge of geological time to determine the age of geomorphological structures. In contrast, the Tanzanian curriculum prescribed the simplified geological time as a mandatory content element of the chapter dedicated to Earth's structure and its crust's petrographic composition. Information on the golden spike was missing from all curricula.

Table 2. Distribution of segments across the sample

Country	Anthropocene	Geological time	Golden spike	Population growth	Industrialization	Globalization	Artificial radionuclides	Carbon dioxide	Greenhouse gases
Angola	0	0	0	4	0	0	0	0	0
Argentina	0	0	0	3	1	1	0	0	0
Austria	0	0	0	2	0	2	0	0	0
Belize	0	0	0	0	0	0	0	0	0
Bermuda	0	0	0	0	0	3	0	0	0
Bolivia	0	0	0	0	0	9	0	0	0
Brazil	0	0	0	0	7	37	0	0	2
Cape Verde	0	0	0	11	0	0	0	0	0
Cameroon	0	0	0	0	0	1	0	0	0
Canada	0	0	0	13	1.5	6.5	0	1	2
Chile	0	0	0	0	1	0	0	0	0
Colombia	0	0	0	1	0	5	1	0	0
Congo	0	0	0	13	0	0	0	0	0
Costa Rica	0	0	0	3	4	0	0	0	0
France	0	0	0	2	2	0	0	0	0
Germany	0	0	0	6.5	0	10.5	0	0	0
Ghana	0	0	0	0	0	0	0	1	5
Guyana	0	0	0	0	0	0	0	0	1
Honduras	0	0	0	10	0	13	0	0	0
Hungary	0	0	0	2	0	8	0	0	0
Ireland	0	0	0	8	1	0	0	0	1
Italy	0	0	0	0	0	0	0	0	0
Ivory Coast	0	0	0	0	0	0	0	0	0
Jamaica	0	0	0	23	0	0	0	0	0
Liberia	0	0	0	0	0	0	0	0	0
Liechtenstein	0	0	0	6	3	3	0	0	1
Mauritius	0	0	0	0	0	2	0	0	1
Mexico	0	0	0	8	0	2	0	0	0
Mozambique	0	0	0	1	0	1	0	0	0
Moldova	0	1	0	10	0	0	0	0	0
Namibia	0	0	0	18	0	1	0	0	0
New Zealand	0	0	0	0	0	0	0	0	0
Niger	0	0	0	11	3	0	0	0	0
Panama	0	0	0	11	0	20	0	0	0
Paraguay	0	0	0	0	0	0	0	0	0
Portugal	0	0	0	9	0	0	0	0	0
Romania	0	0	0	4	0	0	0	0	0
Rwanda	0	0	0	17	25	0	0	0	0
Samoa	0	0	0	2	0	0	0	0	0
Singapore	0	0	0	15	0	0	0	1	1

South Africa	0	0	0	0	1	0	4	0	0	0
South Sudan	0	0	0	0	0	0	0	0	0	0
Spain	0	11	0	0	8	11	0	0	0	0
Sweden	0	0	0	0	0	0	0	0	0	0
Tanzania	0	4	0	0	0	0	0	0	0	0
Thailand	0	0	0	0	0	0	0	0	0	0
Trinidad and Tobago	0	0	0	6	6	18	0	0	0	0
Uganda	0	44	0	14	14	17	0	0	0	0
Uruguay	0	0	0	0	0	0	0	0	0	0
Zimbabwe	0	3	0	0	0	0	0	0	0	0
Total	0	285.5	0	77.5	171	5	3	14	0	0

Population Growth

The thirty-two curricula discussing demographic dynamics embedded the phenomenon into specific conceptual networks, often left its historical development unconsidered, and addressed the topic at various scales. Whereas three curricula only mentioned the concept (Colombia, Costa Rica, Mozambique, and Sāmoa), the curricula of five countries (Canada, Cape Verde, Honduras, Jamaica, and Uganda) dedicated extensive attention to population growth. The remaining twenty-three curricula contained a balanced discussion of the topic.

With the majority prescribing population growth as a mandatory concept, only a few curricula (e.g., Moldova and Tanzania) entailed specific demographic content, such as fertility and mortality. Also, population growth appeared nested in fourteen conceptual networks across the sample (Figure 1). Regarding the Anthropocene, particularly relevant curricular content reflected on the interrelation between population growth and the environment (especially addressing the greenhouse effect); the interplay between population dynamics, resources, and economic activities (including human development); as well as the individual responsibility (reproductive behavior). Population growth was part of such content in eight curricula.

The majority of the thirty-two curricula explored population growth in the present. Only four case studies emphasized its historical development, and only the French curriculum considered the global population at the expense of the national demographic development.

Most curricula addressed population growth at several scales (Table 3). Nevertheless, the global and national scales prevailed. Most case studies, however, introduced demographic development at various scales in different thematic units, with only a few curricula prescribing comparative perspectives across various scales.

Industrialization

The second process leaving stratigraphic evidence is the ongoing process of industrialization. The concept shaped the content of fifteen curricula as part of specific conceptual matrices presented at various scales, mainly in combination with historical development and current status. The Rwandan curriculum extensively discussed the concept, but its

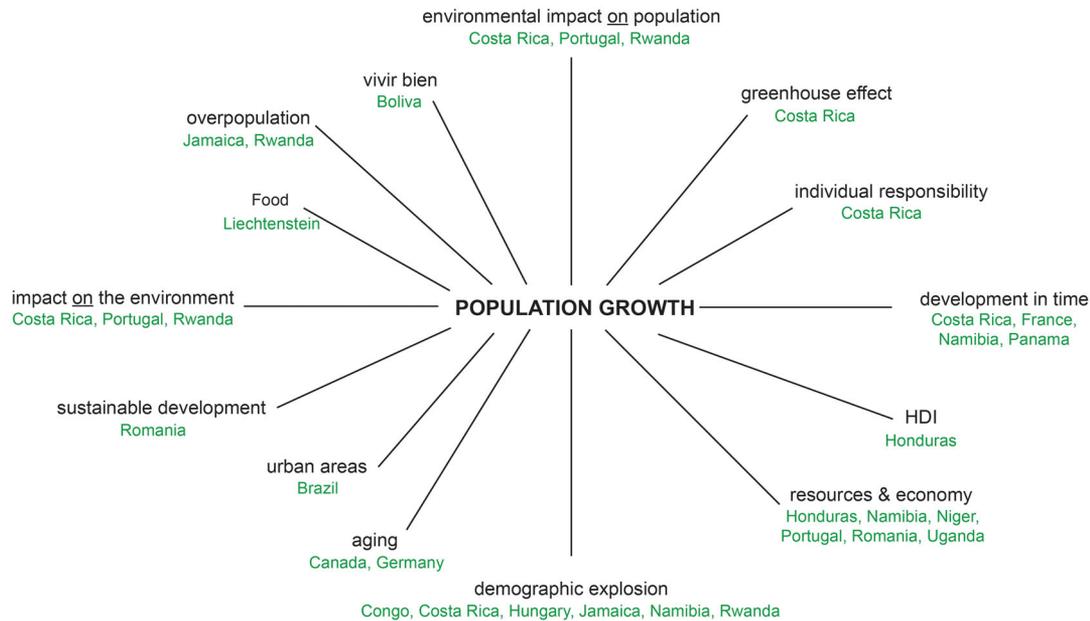


Figure 1. Population growth and its conceptual network.

Argentinian, Irish, and South African counterparts briefly mentioned it. The remaining curricula offered a balanced presentation of the phenomenon.

Nine main conceptual networks integrated the concept of industrialization (Figure 2). In addition, the temporal perspective tracing back the stratigraphic and atmospheric impact of industrialization to its early days during the Industrial Revolution is essential. Nine curricula explicitly addressed the history of industrialization, and six countries (Chile, Costa Rica, France, Niger, Rwanda, and Spain) opted to discuss their industrial past within the framework of global industrialization. As a result, the prevailing scale tied to the process of industrialization was global, followed by the national. In addition, the curricula often prescribed comparative perspectives based on scale.

Globalization

The third component describing the Great Acceleration is globalization. The content of twenty curricula included the concept of globalization focusing on the present, along with four main conceptual dimensions, and predominantly following a comparative view. Except for five curricula (Argentina, Canada, Cameroon, Mozambique, and Namibia), all case studies exhibited a balanced introduction of the concept.

All twenty curricula introduced globalization by discussing at least one of its four main dimensions: economic, political, cultural, and financial (Figure 3). In addition, the Austrian curriculum connected the topic to the overarching objective of global learning (learning for the one world), and several Latin American curricula were very critical of globalization or even adopted an antiglobalization stance.

The temporal emphasis of all curricula was in the present. Nevertheless, they also offered an explanatory background of the process, revealing its development in time. Concerning scale, all curricula focused on the national territory and its place in the globalized world. As a result, scale appeared as a constant contrast between the national and the global. In addition, some curricula complemented this bipolar scalarity by a subnational scale (Canada and Uganda) and a supranational regional scale (Latin America in Honduras and Panama and developing countries in Honduras).

Artificial Radionuclides

Except for the Colombian and South African curriculum, the topic of artificial radionuclides was missing from the sample. The Colombian curriculum focused on nuclear waste and the challenges connected to its disposal and management. In contrast, the South African curriculum discussed the Nuclear

Table 3. Population growth according to scale

	Scale		
	National	Continental	Global
Angola	✓	✓	✓
Argentina	✓		✓
Austria	✓		
Belize			
Bermuda			
Bolivia			
Brazil			
Cape Verde	✓		
Cameroon			
Canada	✓		✓
Chile			
Colombia			
Congo	✓		✓
Costa Rica	✓	✓	
France			✓
Germany	✓		✓
Ghana			
Guyana			
Honduras	✓	✓	
Hungary			
Ireland			✓
Italy			
Ivory Coast			
Jamaica	✓		✓
Liberia			
Liechtenstein	✓		✓
Mauritius			
Mexico	✓		✓
Mozambique			
Moldova	✓		✓
Namibia	✓		✓
New Zealand			
Niger		✓	✓
Panama	✓	✓	
Paraguay			
Portugal			✓
Romania			✓
Rwanda	✓		✓
Samoa			
Singapore	✓	✓	
South Africa			✓
South Sudan			
Spain	✓	✓	
Sweden			
Tanzania			
Thailand			
Trinidad and Tobago			
Uganda	✓	✓	✓
Uruguay			
Zimbabwe			

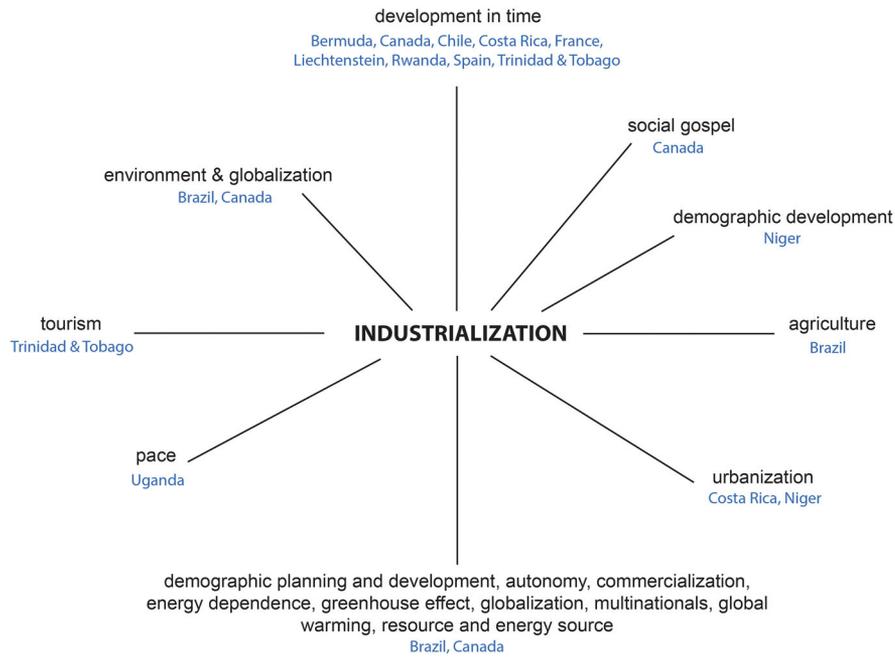


Figure 2. Industrialization and its conceptual network.

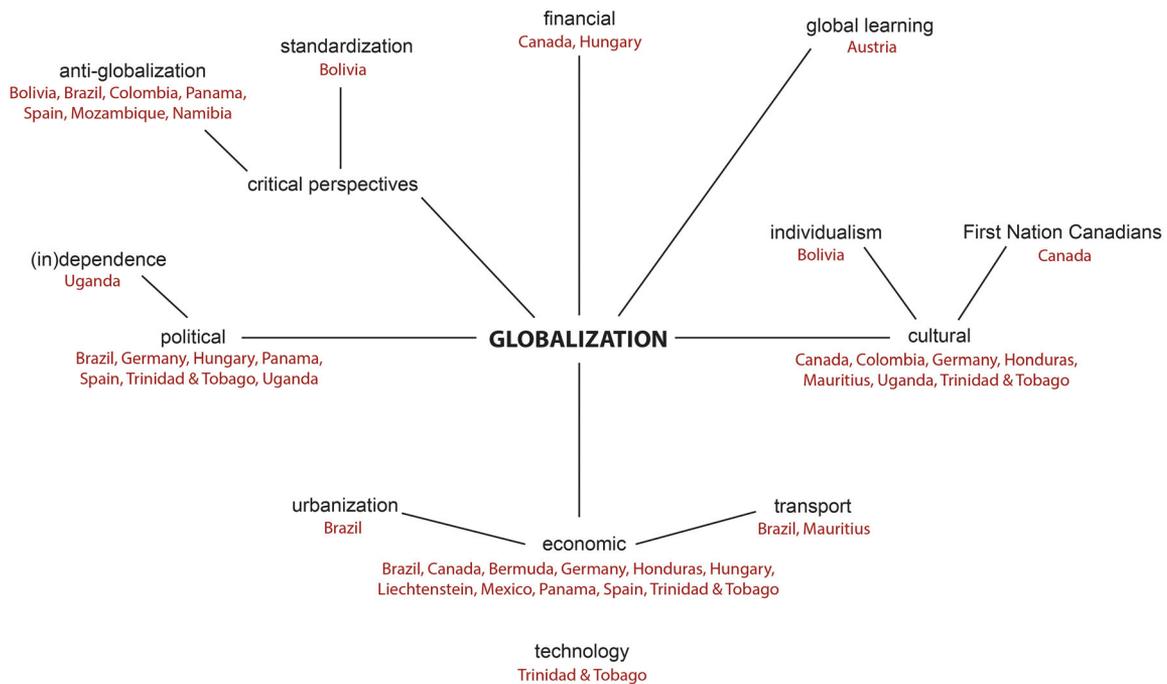


Figure 3. Globalization and its conceptual network.

Age and the Cold War as part of its chapters dedicated to history.

Carbon Dioxide and Other Greenhouse Gases

Three curricula prescribed CO₂ as mandatory content. Whereas the Singaporean curriculum

referred to carbon dioxide in discussing photosynthesis in the tropical rainforest, its Ghanaian counterpart listed CO₂ as one of the greenhouse gases produced during farming. Similarly, the Ontario curriculum linked CO₂ emissions to human activities resulting from an interplay of available

resources, population density, and prevailing economic activities.

Four curricula addressed other greenhouse gases when introducing the carbon offset (Canada), global warming (Guyana and Mauritius), and climate change (Ghana). It was exclusively the Ghanaian curriculum that listed CO₂, CH₄, water vapor, and nitrous oxides as exemplary greenhouse gases. In addition, five curricula (Brazil, Canada, Ireland, Liechtenstein, and Singapore) prescribed the greenhouse effect as mandatory content. Direct references to greenhouse gases, however, were missing from these curricula.

Discussion and Outlook

The results of this study lead to five main characteristics of the ways fifty curricula introduced the Anthropocene. First, all curricula implicitly addressed the Anthropocene. Given the relevance of the concept to geography as an academic discipline (Castree 2014a, 2014b, 2014c) on the one hand and the centrality of human–environment interactions to geography as a school subject (IGU-CGE 2016) as well as its crucial role for ESD (Haubrich, Reinfried, and Schleicher 2007; Bagoly-Simó 2013) on the other hand, the missing explicit mentioning of the Anthropocene in the curricular documents reflects the mismatch between the progress of the academic discipline and the conceptual update in geography as a school subject. Educating for a more sustainable future, however, requires, especially in the field of human–environmental interaction, students to apply the best available expert knowledge when designing alternatives to unsustainable processes and structures they encounter.

Second, the representation of the Anthropocene remains, in the majority of the analyzed curricula, fragmented and limited to a few of its features. The results showed an equal share (one fifth) of curricula entailing at least three or none of the nine categories defining the Anthropocene. With population growth, globalization, and industrialization accounting for two thirds of all segments, the analyzed curricula address traditional topics of geography as a school subject (Bagoly-Simó 2013). Surprising is the modest share (11 percent) of the segments dedicated to greenhouse gases and CO₂ (Crutzen and Stoermer 2019; Crutzen 2002), given the substantial contribution of the subject to discussing climate change (Bagoly-Simó 2013; Chang and Kidman 2018). Despite referencing at least three of the categories defining the Anthropocene, the curricula rarely linked these categories—a vital prerequisite to understanding the

Anthropocene. Consequently, students seem to be exposed to disparate knowledge on the essential processes that induced and have sustained the Anthropocene. Future curricular reform should explore ways to better link these processes, including principles of ESD (Haubrich, Reinfried, and Schleicher 2007; IGU-CGE 2016).

Third, geological time is a neglected topic in all but two geography curricula (Moldova and Tanzania). In addition, the analyzed curricula predominantly focused on the present, which might originate from the traditional and artificial division between history (time) and geography (space) underlying curriculum development. Understanding the magnitude and speed of human impact on the planet, however, requires its contextualization in (geological) time. Therefore, based on the results, a reevaluation of the key concept time (Clifford et al. 2009) in geography curricula might facilitate students' access to the chronology of change inherent to population dynamics, industrialization, globalization, development, system, environment, and other processes.

Fourth, addressing the Anthropocene requires both a flexible and comparative approach to scale. The results of this article indicate that most curricula prefer the national or the global scale, with the fewest examples comparing, in a systematic manner, structures and processes at least at two scales (e.g., Mexico and the world or Panama in the Americas and the world). Of course, negotiating a more flexible use of the key concept scale in the teaching and learning of geography reaches beyond its immediate necessity for a better understanding of the Anthropocene and for ESD implementation (Bagoly-Simó 2013, 2014).

Fifth, this study's results uncovered only a few differences between geography as an independent subject or as part of a compound school subject. Interestingly, it was compound subjects that featured the highest number of categories describing the Anthropocene, dominated the group of curricula void of any such categories, and discussed artificial radionuclides. Despite the very different curricular cultures, geography in compound subjects often seems to connect with history and political science by stressing its human geographical side to the detriment of physical geography. The independent subject of geography has a limited contribution to the discussion of greenhouse gases or geological time and strata. Based on the data presented in this article, when geography was to assume its role as the subject exploring “human-not-human relationships,” as

Castree (2014c, 474) emphasized, the not-human needs to be reinforced. Of course, this translates into a strengthening of physical geography to enable the exploration of new connections between geographical subdisciplines that “transcend the all-too-familiar (and thankfully unrealistic) aspiration for a holistic approach” (Castree 2014c, 474) inherent to integrative dilutions of the discipline. Linking back to the debates on a new physical geography, Bagoly-Simó and Uhlenwinkel (2016) described a range of challenges that physical geography faces in school curricula. Understanding the Anthropocene, however, requires both solid physical geographical knowledge and clear links between the human and the nonhuman—a pressing matter for both geography and compound subject curricula.

This article offers a first insight into the ways in which geography curricula for lower secondary education addressed the Anthropocene. In addition, it contributes, based on a large sample, to comparative curricular research in geography education (Chang and Kidman 2018). Nevertheless, both its conceptualization and operationalization bear limitations. On the conceptual side, alternative definitions of the Anthropocene might uncover a different contribution to teaching this central topic. Also, opting for a more geoscientific framework instead of ESD would lead to other findings that would be relevant for geography education in other ways. On the methodological side, the content analysis revealed a rich conceptual network that integrated the concepts of population growth, industrialization, and globalization. Future qualitative work based on an in-depth analysis (e.g., Bagoly-Simó 2014) could identify additional conceptual links supporting both ESD and the Anthropocene concept. Such studies could also be more sensitive to the approach (thematic, regional, or combined) the individual curricula followed as well as to their architecture covering aspects, such as educational aims, key concepts, standards, content, and presentation (in a brief schematic or extensive textual format). In doing so, they would contribute to much-needed comparative curricular studies (Lidstone and Stoltman 2007; Bagoly-Simó 2017; Chang and Kidman 2018), particularly regarding geography’s contribution to and role in compound subjects. Finally, the sampling process would require an exploration of curricula published in other languages. The work presented in this article could not consider India, China, Japan, and a range

of countries with curricula published in various Slavic, African, Asian, and Australasian languages.

Summing up, this study’s results offered a first insight into the way geography curricula of fifty selected countries discussed the Anthropocene. Based on the results, several recommendations were formulated that could create a minimal framework to discuss this timely concept. Future work addressing the limitations of this study could offer in-depth information and specific recommendations matching the formal requirements of national or regional curricular traditions, approaches, and political objectives tied to the curriculum and the expert geographical knowledge to which future generations should receive access.

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