Summary of a meta-synthesis about secondary education students and climate change

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Abstract

This paper presents the supplementary material and summary of the article titled "Climate Change Education and Secondary School Students: A Meta-Synthesis (1993-2017)," which has been accepted for publication in the journal Education in the Knowledge Society (EKS). Within it, we provide a characterization of the studies identified through a systematic review approach, followed by a summary of the main results.

Characterization of climate change education among secondary education students

Table 1 presents the characterization of climate change education research among secondary education students between 1993 and 2017. For a more detailed analysis, we suggest accessing the main article to which this work refers.

Table 1. Characterization of the research relating to climate change education and secondary school students (1993–2017)

			Educational level								Sample			
	Year		6	7	8	9	10	11	12	Research design	≤100	101-200	201-400	>400
Boyes et al.	1993	UK	x	x	x	x	x			Quanti				702
Rye et al.	1997	USA		x	x	x				QUALI	24			
Adams.	1999	USA							x	QUALI	10			
Daniel et al.	2004	UK		x		x		x		Quanti				582
Boyes et al.	2008	China			x			x		Quanti				676
Schuster et al.	2008	USA						x	x	QUALI	9			
Arto-Blanco	2009	Spain		x	x	x	x	x	x	MIXED				640
Boyes et al.	2009	USA		x	x	x	x			Quanti				500
Kilinç et al.	2009	Turkey		x	x					Quanti		144		
Rule & Meyer	2009	USA				x	x	x	x	MIXED	100			
Aydin	2010	Turkey				x	x	x	x	QUALI		166		
Boon	2010	Australia					x			Quanti			310	
Rodríguez et al.	2010	Spain		x	x	x	x			Quanti				1460
Chookar et al.	2011	India		x	x	x	x			Quanti				768
Dijkstra & Goedhart	2011	Europe		x	x	x	x	x	x	Quanti				1370
Kilinç et al.	2011	Turkey		x	x	x	x			Quanti				897
Liarakou et al.	2011	Greece			x	x	x	x		Quanti				626
Malandrakis et al.	2011	Greece		x	x	x	x			Quanti				1444
Punter et al.	2011	Spain		x	x	x	x			MIXED			379	
Shepardson, Choi, et al.	2011	USA		x						QUALI			225	
Shepardson, Niyogi et al.	2011	USA		x	x	x	x	x	x	QUALI	51			
Sternäng & Lundholm	2011	China					x			QUALI	9			

Ambusaidi et al.	2012	Oman	x	x	x	x	x	x	x	Quanti					1532
Barbosa et al.	2012	Brazil				x				QUALI	35				
Boyes & Stanisstreet	2012	UK	x	x	x	x	x			Quanti					961
Dijkstra & Goedhart	2012	Europe		x	x	x	x	x	x	Quanti					671
García-Rodeja & Lima	2012	Spain					x			MIXED	22				
McNeill & Vaughn	2012	USA						x	x	MIXED	22/75				
Reinfried et al.	2012	Switzerland			x					MIXED				289	
Sternäng & Lundholm	2012	China					x			QUALI	12				
Barros & Pinheiro	2013	Brazil			x		x	x		QUALI				323	
Sellmann & Bogner	2013	Germany				x	x	x	x	Quanti			114		
Harker-Schuch & Bugge-Henriksen	2013	Austria / Denmark						x		Quanti			188		
Niebert & Gropengiesser	2013	Germany							x	QUALI	35				
Öhman & Öhman	2013	Sweden						x		QUALI	93				
Peters & Songer	2013	USA		x	x	x				QUALI			106		
Yazdanparast et al.	2013	Iran				x	x	x		Quanti					1035
Niebert & Gropengießer	2014	Germany							x	QUALI	35				
Boyes et al.	2014	11 countries		x	x	x	x	x		Quanti					12627
Bodzin & Fu	2014	USA			x	x				Quanti					956
Bodzin et al.	2014	USA			x	x				Quanti					868
DeWaters et al.	2014	USA		x	x					Quanti					427
Flora et al.	2014	USA				x	x	x	x	Quanti					1241
Stevenson et al.	2014	USA	x	x	x					Quanti				378	
Özdem et al.	2014	Turkey		x						Quanti					646
Oztas et al.	2014	Turkey					x			Quanti				242	
Reinfried & Tempelmann	2014	Switzerland			x					QUALI	14				
Shepardson et al.	2014	USA		x						QUALI	42				
Chang & Pascua	2014	Singapore			x					MIXED				397	
Karpudewan et al.	2015	Malaysia						x		MIXED	73				
Dawson	2015	Australia				x				MIXED					438/20
Espejel y Flores	2015	Mexico						x	x	MIXED	85				
Calixto-Flores(a)	2015	Mexico		x	x	x				Quanti	88				
Calixto-Flores(b)	2015	Mexico		x	x	x				QUALI	46				
Nussbaum et al.	2015	USA		x						Quanti			119		
Sellmann et al.	2015	Germany					x	x	x	MIXED	95				
Tasquier	2015	Italy						x		QUALI	28				
Chang & Pascua	2016	Singapore				x				QUALI	27				
Stevenson, Peterson & Bondell	2016	USA		x	x					Quanti					426
Fløttum et al.	2016	Norway					x	x	x	MIXED				223	
Monroe et al.	2016	USA					x			MIXED	22				
Petraglia et al.	2016	Brazil						x	x	QUALI				250	
Shea et al.	2016	USA		x	x					Quanti			127		
Stevenson y Peterson	2016	USA		x	x					Quanti					1267
Stevenson, Peterson & Bradshaw	2016	USA		x	x					Quanti				369	
Lombardi et al.	2016	USA		x						QUALI	85				
Lin	2016	China			x					QUALI	39				
Parant et al.	2016	France					x			Quanti				270	
Hermans & Korhonen	2017	Finland				x				Quanti					549
Jackson & Pang	2017	China		x	x	x	x	x	x	MIXED	34				1383
Karpudewan & Mohd Ali Khan	2017	Malaysia						x		MIXED	62				
Chang et al.	2017	Singapore					x			QUALI	27				
Bello-Benavides et al.	2017	Spain / Mexico						x	x	QUALI			155		
Holmqvist & Olander	2017	Sweden							x	MIXED	51				
Tasquier & Pongiglione	2017	Italy						x	x	MIXED	48				
Stevenson et al.	2018*	USA						x	x	Quanti					950

Note: Level 6 (11-12 years old), L7 (12-13), L8 (13-14), L9 (14-15), L10 (15-16), L11 (16-17), L12 (17-18). Quanti = quantitative design; QUALI = qualitative design; MIXED = mixed methods design. The year of publication in this table refers to the online publication, so some of the citations may not match the reference list.

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Summary

Our findings indicate that the understanding of CC among secondary school students encompasses various elements, with personal and socio-cultural contexts, as well as exposure to risk-related situations, playing pivotal roles. For instance, groups of students in Turkey and Mexico prioritize air pollution as a major concern based on their personal experiences and those of their relatives (Calixto-Flores, 2015b; Özdem et al., 2014). Interestingly, despite flooding being a widely acknowledged consequence of CC, it is not as prominently represented in their concerns. A similar pattern emerges among certain students in Brazil, who, when questioned about their CC-related worries, express concerns about the lack of public services in their neighborhoods (Petraglia et al., 2016). This trend is also observed in ethnic minority students from the United States residing in urban areas affected by the urban heat island effect (Stevenson et al., 2014).

However, despite the differences among the student groups in the analyzed studies, common patterns can be discerned, particularly concerning the conceptual knowledge held by the students. Secondary school students predominantly engage with information that emphasizes the general biophysical causes and consequences of the climate crisis. In contrast, their exposure to information regarding potential solutions or the socioeconomic implications of CC is more limited. The prevailing understanding of the climate system tends to lean toward a perception of unidirectional and linear cause-and-effect relationships, overlooking the feedback processes intrinsic to the complexity of the climate system and its interactions with human societies (Dawson, 2015; Shepardson et al., 2014; Lombardi et al., 2016). Although certain educational interventions appear to enhance their knowledge (Rule & Meyer, 2009; Tasquier & Pongiglione, 2017; Karpudewan & Mohd Ali Khan, 2017; Bodzin & Fu, 2014), a considerable number of students still encounter challenges in grasping certain climate concepts (McNeill & Vaughn, 2012; Punter et al., 2012; Bodzin & Fu, 2014).

In summary, students exhibit a superficial understanding of the climate crisis and its human dimensions. Their knowledge is influenced by the atmospheric dynamics of the climate crisis and its overarching and general causes (Lin, 2016; Adams, 1999; Espejel & Flores, 2015; Shepardson et al., 2014; Harker-Schuch & Bugge-Henriksen, 2013). Additionally, students frequently encounter challenges in articulating a coherent description, often resulting in tautological arguments where "climate change [is presented] as both a cause and consequence of climate change" (Punter et al., 2011, p. 455).

Personal beliefs, identities, and experiences play a significant role in shaping students' perceptions and evaluations of the climate crisis. Convergent and divergent elements align with different frameworks in the public discourse on climate change (Fløttum et al., 2016; Tasquier, 2015). It is evident that the acceptance of climate change is widespread, with the exception of residual percentages among students from the United States and other countries. While the majority acknowledges the issue, uncertainties persist regarding the extent of scientific consensus and explanations involving natural climate change.

Specific anthropic causes, such as industry and transport, are predominantly identified due to their direct association with the atmospheric dimension of climate change. However, other activities related to indirect greenhouse gas emissions, like methane or nitrogen oxides generated by different economic sectors and agents, remain overlooked (Tasquier & Pongiglione, 2017; Boyes & Stanisstreet, 2012). This assessment contributes to the disconnection between everyday lifestyles and their potential consequences on the climate system and the lives of others.

This psychological distance facilitates the externalization of responsibility for the problem to entities such as governments, industries, or humanity, perceived as abstract entities. The outsourcing of responsibilities, functioning as a psychosocial mechanism to attribute the causes of climate change to other agents, appears to persist in the hope of finding solutions.

Interestingly, higher confidence levels are expressed in others' ability to solve the problem rather than in an individual's capacity (Peters & Songer, 2013; Nussbaum et al., 2015; Stevenson & Peterson, 2016; Bodzin & Fu, 2014).

The socioeconomic level is another variable that seems to influence this stance, particularly in direct association with groups of low socioeconomic status. These groups are more exposed to risks and demonstrate increased vulnerability to the impacts of extreme meteorological phenomena and other adverse climate events (Stevenson, Peterson & Bradshaw, 2016; Stevenson et al., 2014; Petraglia et al., 2016).

Regarding attitudes, studies indicate enhancements in pro-environmental attitudes and motivation after specific educational interventions (Sellmann & Bogner, 2013; Shea et al., 2016; Flora et al., 2014; Karpudewan & Mohd Ali Khan, 2017). However, disparities emerge based on personal, social, and cultural determinants, even within the same local context (Tasquier, 2015). Notably, gender socialization stands out as a differentiating factor, with women exhibiting a more ecocentric approach, greater concern, and a higher willingness to take pro-environmental actions (García-Vinuesa et al., 2020).

Conversely, exploring and understanding subjective and intersubjective barriers stemming from the lifestyle prevalent in most consumer societies, such as Australia, Spain, or the United Kingdom (Boyes & Stanisstreet, 2012; Boyes et al., 2009; Rodríguez et al., 2010), is crucial for proposing more effective educational responses to the climate crisis. In these three countries, students exhibit reluctance to purchase new products or alter their diets, overlooking the risks and responsibilities associated with a hyper-consumerist lifestyle that underlies the climate crisis. Similar negative trends are observed in Chinese adolescents rejecting restricted use of private vehicles (Sternäng & Lundholm 2011) and in a U.S. study where students hesitate to carry a reusable water bottle due to potential social stigma among peers (Flora et al., 2014). However, in societies and cultures where nature is not perceived merely as a resource bank for

exploitation (Chhokar et al., 2011), positive attitudes are evident. For instance, a study in India showcases students' greater willingness to take positive actions for the environment and for the human beings who are part of it (Chhokar et al., 2011).

Limitations

The debate surrounding methods for conducting knowledge synthesis is well-documented, as are the associated challenges and opportunities. These encompass addressing findings from diverse sources, adapting techniques from other research fields, particularly in health, to the realm of social sciences, selecting an appropriate knowledge synthesis approach for the research purpose, and acknowledging contradictions and evolutions within specific or general research fields (Gutierrez-Bucheli et al., 2022). Consequently, inherent limitations exist in this type of study. Alongside common limitations like publication bias, limited access to certain published works, and language proficiency challenges (as in our case, restricting studies to those in English, Spanish, or Portuguese), we've encountered difficulties stemming from the diversity of epistemologies and research traditions used to explore and reference various cognitive elements involved in representing complex phenomena such as climate change (CC). In conclusion, we acknowledge the time span covered by this review, given the six-year gap. However, beyond questioning its timeliness, this gap allows us to trace back to the origins of what, thirty years ago after the Earth Summit in Rio de Janeiro, was not yet recognized as a significant climate emergency, with the devastating and enduring impacts we now associate with it. To underscore its urgency, the United Nations acknowledges in the special edition of the latest Sustainable Development Goals (SDGs) report the necessity for a rescue plan addressing both humanity and the planet.

Our contribution holds historical significance in a context that requires references from the past to navigate towards a more promising future. This relevance becomes particularly apparent

when considering the need to reevaluate the world and its realities post-pandemic challenges such as those posed by Covid-19, along with conflicts in Ukraine, Gaza, and numerous others. Certainly, our work not only illuminates the current landscape but also lays the groundwork for potentially impactful future research directions. Presently, we are actively engaged in updating this review until 2024, focusing on applying eligibility criteria to the titles and abstracts of 430 records sourced from the WOS and Scopus databases. Within this phase, we have identified 128 articles that require thorough analysis to determine the final number of studies addressing the representation of CC among secondary education students in the 2018-2024 interval. This ongoing effort holds particular relevance, given the substantial number of studies published in recent years on CCE.

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