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14 Climate change as a socio-scientific issue in upper secondary education

Addressing wicked problems through crosscurricular approaches

Pia Sjöblom, Lili-Ann Wolff, and Jessica Sundman

Introduction

> We use the term "wicked" in a meaning akin to that of "malignant" (in contrast to "benign") or "vicious" (like a circle) or "tricky" (like a leprechaun) or "aggressive" (like a lion, in contrast to the docility of a lamb).
>
> (Rittel & Webber, 1973, p. 160)

Climate change is an example of a so-called wicked problem (Rittel & Webber, 1973). According to the Paris Agreement (United Nations [UN], 2015), the legally binding international treaty intended to combat climate change, global warming should be held "well below 2°C above pre-industrial levels" and efforts made "to limit the temperature increase to 1.5°C above pre-industrial levels" (p. 3). These goals represent a challenge more than sufficient to fulfill the criteria for a wicked problem, as economic and political interests conflict with the ecological realities. As of 2023, no democratic state has implemented a climate plan that adequately meets the requirements of the Paris Agreement. Moreover, according to Willis et al. (2022), political systems might need to be reformed before the climate crisis can be addressed.

Undoubtedly, the solutions to wicked problems are neither precise nor permanent, while the range of available solutions are limited to what is feasible and imaginable from the perspective of the most powerful global political and economic actors rather than being based on what is most crucial for the climate. Furthermore, stakeholders' worldviews form how they distinguish wicked problems and how they develop related solutions (Kawa et al., 2021). In contrast to "tame problems," wicked problems have unintended consequences within an infinite time frame, and those unintended consequences are impossible to trace (Rittel & Webber, 1973). There is no escape from wicked problems. They pose an existential threat to humanity's survival (Birdsall, 2022) and cannot be resolved without changing the very society that created them (Rittel & Webber, 1973). To accentuate the wickedness, Levin et al.

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(2012) suggest the concept of "super wicked problems," which have the following four features: "time is running out; those who cause the problem also seek to provide a solution; the central authority needed to address it is weak or non-existent; and, partly as a result, policy responses discount the future irrationally" (p. 123).

It is challenging to address these kinds of huge problems through education, and the education of today might not even be extensive enough to do so. An alternative could be the approach Klafki (1998) posits based on the concept of Bildung (see also Chapter 3). More specifically, to didactically address urgent global issues, such as the environmental crisis, social inequity, and war, Klafki (1998) proposes working with what he calls "epochal key issues" (epochentypische Schlüsselprobleme). Wicked problems such as climate change are definitely epochal key issues. Climate change education, according to Klafki's (1998) approach, encourages students to argue based on critical reflection as well as empathy. Consequently, wicked problems are epochal key issues that cannot be grasped from merely a disciplinary and cognitive perspective.

Given their inherent complexity, wicked problems demand transdisciplinary approaches (e.g., Gibbs & Beavis, 2020; Kawa et al., 2021). Thus, conventional education alone cannot deal with such challenges, prompting researchers to call for multi-, inter-, and transdisciplinary educational approaches (e.g., Evans, 2015; Wolff, 2022), which in the school context entail multi-, inter-, and transcurricular teaching – that is, crosscurricular teaching (see Chapter 2). In the research context, cross-disciplinarity occurs in many forms. Hence, multidisciplinary research implies the interaction of several disciplines, whereas interdisciplinary research implies coordinated collaboration among researchers from many disciplines (Pohl & Hadorn, 2008). Transdisciplinarity represents the most advanced form of collaboration and requires joint research and learning processes involving both researchers and non-academics (Wolff, 2022). Therefore, transdisciplinary research involves researchers, policymakers, and other stakeholders being engaged in a common multidimensional learning process that strives toward achieving real-world changes (Gibbs & Beavis, 2020; Roux et al., 2017). When we use the term "crosscurricular" in this chapter, we refer to education based on all the forms of interplay or collaboration described earlier, whereas the term "transcurricular" refers to the most complex form – that is, transdisciplinary research (see also Chapter 2).

Education needs to shift toward stronger crosscurricularity to meet the demands of climate change (Rousell & Cutter-Mackenzie-Knowles, 2020). In addition to crosscurricularity, there have been research-based and political requests for educational actions to identify solutions to the climate change dilemma. There have also been requests for transformative learning. The transformative learning process encourages students to reflect on their previous experiences and preconceptions, including hidden values and assumptions. The aim is to make them think critically and become part of rational discourses (Mezirow, 1991). According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) (n.d.), the mitigation of climate change requires an education that holistically addresses the ecological, economical, and social dimensions of the problem and aims to foster change at both the individual and societal levels. Sustainable Development Goal (SDG) number 13 – that is, "Climate action" – calls for the implementation of transformative learning approaches to encourage engagement. This is not an easy task, as transformative learning is a complicated process developed for adult learning, and further, it is not possible to predict its outcomes (Taylor, 2009). As a sense of hope and efficacy is necessary to drive climate change mitigation, a central aim of climate change education is to empower students. Indeed, people who are both willing to act and capable of making informed decisions represent the most crucial prerequisites for a sustainable future.

In this chapter, we discuss climate change as an example of a wicked problem and a socio-scientific issue. We argue for the importance and urgency of including climate change in education. Moreover, based on a review of previous research and Finnish policy documents, we present alternative routes to a cross-curricular teaching approach more generally. The chapter begins with a review of relevant literature and then continues with a discussion of how the core curriculum of Finnish upper secondary education deals with the climate change topic. Our focus here is on geography education. As the present study is limited to a discussion of curriculum and literature, it does not reflect the real situation in the classroom, which is beyond the scope of this chapter (but see Chapter 13 for an empirical study of education for sustainable development in two Danish classrooms). Although geography has a long history as a discrete subject, in different parts of the world it is variously associated with the humanities, social studies, and natural sciences fields (Lambert et al., 2015). In Finland, geography belongs to the science field within the school curriculum and includes both physical and cultural geography. Taking Finland as an example, we aim to highlight crucial didactical elements built on a cross- and transcurricular approach when teaching about wicked problems. Yet, we will first present the challenges and obstacles from a science education perspective, starting with the notion of scientific literacy, which is widely recognized as an overall aim of science education.

Scientific literacy aiming for climate action

The aims of science education are relevant to how contemporary society addresses wicked problems such as climate change. In this regard, science education intended to foster scientific literacy is crucial, although there are many interpretations of what such literacy actually entails. Roberts (2007) proposes two visions for scientific literacy, which he describes as "idealized extremes." Vision I focuses on the content and processes of science, with the aim being to, for example, learn basic science content relevant to further studies. By contrast, Vision II focuses on real situations, wherein science knowledge aims at fostering, for instance, critical reflections and informed decisions concerning issues involving science (Roberts, 2007; Roberts & Bybee, 2014).

Climate change is an extremely complex process that is difficult for students to understand (e.g., Lee et al., 2020; Sjöblom et al., 2022). In addition, the growing amount of fake news and misinformation regarding various scientific issues represents a significant cause for concern (Nguyen & Catalan-Matamoros, 2020) and these news contribute to climate change denial (Jylhä, 2018; Valladares, 2021), which hampers mitigation efforts (Jylhä, 2018). Hence, there has been a call for a renewed focus on scientific literacy among the public (Valladares, 2021). Accordingly, critical reflection, knowledge, and understanding are all considered cornerstones of climate change education. This is important because critical reflection without knowledge of scientific research methods may result in waning confidence in science.

More recent research on science education has contributed to the development of a third vision of scientific literacy – namely, Vision III (e.g., Liu, 2013) – which is more strongly related to society, including elements of social engagement and both individual and collective agency (Valladares, 2021). Sjöström and Eilks (2018) discuss Vision III in relation to the concept of Bildung in the sense of how students develop and learn through interaction with surrounding society. They describe the aim of Bildung-oriented science education to be the "transformation of both the individuals/citizens/subjects and the society towards sustainability and development" (Sjöström & Eilks, 2018, p. 82). Consequently, the third vision of scientific literacy is crucial to Bildung-oriented science education. However, the development of Vision III does not imply that Vision I and Vision II are obsolete (Kubisch et al., 2022; Liu, 2013; Valladares, 2021). In fact, according to Valladares (2021), scientific knowledge and thinking are crucial in relation to both participation in democratic processes and society's efforts to address global risks. Furthermore, Vision II and, particularly, Vision III require interdisciplinary and transdisciplinary approaches to education (Kubisch et al., 2022). In addition, they stress that the realization of all three visions of scientific literacy can also meet the requirements of sustainability. As extremely complex and value-based wicked problems demand both a Bildung-oriented science education and transcurricular teaching (Sjöström & Rydberg, 2018), student teachers and upper secondary school students have started to call for transcurricular education that encourages the development of students' agency. Students and preservice teachers appreciate the importance of climate change education, although they are skeptical of their capacity for change (Winter et al., 2022). Consequently, future teachers require training during their professional education on how to teach wicked problems and socio-scientific issues in a way that empowers students.

Another concept used in educational research that relates to both scientific literacy and climate change is "climate science literacy," which was defined by the United States Global Change Research Program (USGCRP) in 2009 and subsequently developed by climate scientists and educators (Shwom et al., 2017). It includes seven principles or critical conceptual knowledge statements for achieving climate literacy. Aside from having a scientific understanding, a climate-literate person also knows how to assess information concerning climate, communicate about climate and climate change, and transform informed and responsible decisions into appropriate actions (USGCRP, 2009). Shwom et al. (2017) propose two additional principles to ensure the inclusion of a social science perspective. These principles concern knowledge of climate change as a social and psychological phenomenon as well as of the role of social contexts in climate change mitigation and adaptation (Shwom et al., 2017). The integration of biophysical and social principles within a crosscurricular approach supports a Vision-III-oriented conception of scientific literacy.

Climate change as a socio-scientific issue

As climate change relates to both society and science, it is definitely a socio-scientific issue (SSI). Such issues have traditionally played a crucial role in the promotion of scientific literacy within the field of science education (Zeidler et al., 2019). As an educational theme and research domain within science education, SSIs address sustainability and wicked problems of various kinds. SSIs are also seen as means of working crosscurricularly. Indeed, Evagorou and Nielsen (2019) describe SSIs as issues involving a scientific element and relating to many disciplines and domains, including the political, financial, ethical, and religious domains. Wan and Bi (2020) refer to a study that categorizes socio-scientific topics into six main groups: environmental issues, safety and health, resources and energy, ecological systems, biotechnology, and new materials. Hence, they argue that these topics should be included in the science curriculum to help prepare students to act more sustainably and to become more responsible citizens. In this context, climate change is a self-evident example of an SSI.

SSIs in education can, if the teaching is well planned and well carried out, enable a crosscurricular approach to teaching and learning by combining, for example, reading skills, science, social studies, mathematics, art, moral reasoning, epistemological development, and peer debate (Zeidler & Nichols, 2009). According to Zeidler and Nichols (2009), SSIs naturally integrate school subjects rather than separate them, which can contribute to a more beneficial science education. Zeidler (2014) describes four SSI fundaments, which form the basis for scientific literacy from a sociocultural perspective. First, SSI problems should be personally relevant, controversial, and ill-structured, and they should involve scientific evidence-based reasoning. Second, in the classroom, the topics should encourage discussion and argumentation. Third, the topics should include moral reasoning. Fourth, the topics should be designed to form "virtue and character as long-range pedagogical goals" (Zeidler, 2014, p. 699). All these goals are also goals of Bildung-oriented teaching (see Chapter 3).

One of the main motives for the integration of science with other disciplines is to promote both critical-thinking and problem-solving skills (Czerniak & Johnson, 2014), which are considered crucial to climate change education. Another key motive is the fact that research concerning science education depicts a long-term development with a consistently declining interest in school science and science careers among young people (Osborne, 2003). Among the reasons for this are the disconnection between science education and students' everyday lives. According to Kubisch et al. (2022), relevant topics, including climate change and the role of science in triggering social, economic, and political action, have been neglected. A focus on SSIs can serve to counter this phenomenon and make science more relevant to young people. Working on SSIs in the classroom represents a way of contextualizing science and connecting scientific knowledge to everyday situations (Czerniak & Johnson, 2014), which accords with the perspective of Bildung (Willbergh, 2015).

The linking of science content to everyday life – where there is no subject division – renders science relevant and has the potential to increase students' interest. As various media sources regularly discuss climate change, it has become highly topical for students. Yet, how can climate change education be carried out in schools in a way that is relevant? Based on a review of 49 studies focusing on the assessment of climate change education interventions, Monroe et al. (2019) argue that effective environmental education focuses on personally relevant and meaningful content and uses active and engaging teaching methods. When it comes to climate change education, engaging in deliberative discussions, interacting with scientists, addressing misconceptions, and finally, implementing school and community projects are all promising approaches (Monroe et al., 2019). Interestingly, very few of the reviewed studies describe interventions involving a crosscurricular approach that combines the natural and social sciences. Nevertheless, sustainability problems benefit from cooperation among several disciplines, including at the school level (Kubisch et al., 2021), and the results of the literature review by Monroe et al. (2019) point to strategies relevant to crosscurricular teaching.

In a collaboration among high schools and universities during a one-year school project, more than 100 experts from the climate change, environmental ethics, biology, and geology fields cooperated with teachers and students (Keller et al., 2019; Kubisch et al., 2022). Due to including active and engaging teaching methods, as well as involving cooperation with scientists, the project represents an example of transcurricular teaching (see also Wolff, 2022) that meets the criteria for successful climate change education (Monroe et al., 2019). The fundamental idea was to involve students in research concerning real-world problems in both school and out-of-school settings, beginning with a kick-off event involving climate change experts from various disciplines as well as politicians and activists. This was followed by school lessons on climate change and individual research projects related to the natural and/or social sciences. The project culminated in an Alpine research week, during which the students worked in collaboration with scientists and were involved in research concerning the impact of climate change in Alpine regions. Hence, the perspective is transcurricular. The evaluation of the project was based on data obtained from pre- and posttests, and it revealed that climate change education was successful in the fostered learning environment, which involved transdisciplinary and/or moderate constructivist theories (Keller et al., 2019). For example, the 343 participating students generally rated the innovative methods applied in the project as very beneficial to promoting their understanding of climate change. Both quantitative and qualitative data proved that the classical lessons delivered during the project contributed the least to the students' understanding (Keller et al., 2019).

Crosscurricular climate change education in general upper secondary education

In Finland, compulsory education includes pre-primary, basic, and upper secondary education, with students being enrolled from 6–18 years old. After completing their basic education, students choose either general upper secondary education or vocational upper secondary education. Most Finnish students continue to general upper secondary education, which is considered preparatory for higher education. According to the curriculum, students should not only gain subject-specific knowledge but also develop transversal competences. In educational discourses, the transversal competence concept is used synonymously with generic competence, key competences, twenty-first-century skills, and various other concepts (Wolff et al., 2022). Moreover, it refers to the cognitive and meta skills students might require in their future studies, employment, and daily life, in addition to the skills required to manage in a world characterized by digitalization and change (Finnish National Agency for Education [FNAE], 2020). According to the national core curriculum, these transversal competences are integrated into course objectives and the assessment of upper secondary studies (FNAE, 2020), as well as into the national matriculation examination (Gullberg, 2022).

In the Finnish core curriculum, climate change and sustainable development in general are specified in both school subjects and the transversal competences as requiring crosscurricular teaching. The curriculum lists six transversal competences: wellbeing competence (see Chapter 8), interaction competence, multidisciplinary and creative competence, societal competence, ethical and environmental competence, and global and cultural competence (FNAE, 2020). Climate change can be found within the multidisciplinary and creative competence category, where students learn to reflect on solutions that are sustainable and connected to the environment, economy, technology, and politics, as well as "to produce and evaluate alternative future scenarios from an individual, collective and ecosystem perspective" (FNAE, 2020). The aim of the ethical and environmental competence category is that students are familiarized with the research evidence and practices associated with climate change mitigation and the "activities that can help change these phenomena in a more sustainable direction" (FNAE, 2020).

Geography is one of the subjects into which climate change can be easily integrated. The aims of geography education are both mono- and transcurricular (e.g., Butt & Lambert, 2014), as it aims to foster active global citizenship and develop students who promote a sustainable future. These aims accord with the spirit of Vision III concerning scientific literacy and also with the concept of Bildung (Sjöström et al., 2017). The transversal competences specified in relation to geography within the Finnish core curriculum are emphasized, with the focus being on how students are expected to develop the skills necessary for participatory (regional) planning and to accept global responsibility as active citizens (FNAE, 2020). These subject-specific implementations of transversal competences match with some of the characteristics of SSI education (Zeidler, 2014), as regional planning and participation in planning for a sustainable society can be perceived as personally relevant and engaging, while regional planning demands consideration of various perspectives.

Internationally, there is an attempt to develop a crosscurricular understanding of climate change through incorporating the topic into various subjects within the curriculum, especially geography. According to Onuoha et al. (2021), geography has a responsibility to encourage students to act in a way that reduces the burden of climate change. They even state that climate change, as a topic, is appropriately situated in the geography curriculum (Onuoha et al., 2021). According to Skarstein and Wolff (2020), a sustainability approach in relation to the geography subject both develops content knowledge and fosters engagement in sociopolitical issues such as climate change. On a global scale, sustainability issues, including climate change, have been incorporated into the geography curricula of different countries. Butt and Lambert (2014) refer to this as a double-edged sword, as geographical content knowledge could be set aside in favor of more urgent topics. The disciplinary development of geography has resulted in numerous specialized fields of research, although these fields do not function clearly as support and resources for geography as a school subject. Thus, geography can be seen as a field that has many peripheries but no core (Martin, 2005). Crosscurricular aspirations, such as sustainability education and climate change education, are crucial rationales for geography education, although they cannot serve as a substitute for subject knowledge.

Interestingly, climate change is not mentioned among the overall aims of the geography subject, nor is it featured in the descriptions of the transversal competences of the subject within the Finnish core curriculum. However, it could be included in the "global challenges" topic. By contrast, climate change constitutes a substantial part of the first (and only compulsory) course in geography, which focuses on climate change and sustainable development. Climate change processes and the reasons for and effects of climate change as well as extreme weather events are listed among the central content and can be seen as crosscurricular, as understanding climate feedback mechanisms requires conceptual knowledge of biology (e.g., the carbon cycle), chemistry (e.g., greenhouse gases), and physics (e.g., planetary movement). Climate change mitigation and adaptation also require knowledge of social issues (Monroe et al., 2019; Sjöblom et al., 2022). Consequently, subject teachers need content knowledge from several disciplines as well as specific pedagogical content knowledge if they are to ensure successful teaching and the promotion of students' climate literacy. In addition, subject teachers need didactic tools to teach content and initiate both critical reflections and tangible actions.

In the Finnish core curriculum for upper secondary education, in addition to geography, climate change is mentioned in the descriptions of courses concerning seven subjects, including physics, worldview studies, and various languages. Yet, how the topic is taught depends on the subject teachers' interest and willingness (Gullberg, 2022; Lambert et al., 2015), as well as on the monodisciplinary rationale and history of the subject (see also Chapter 13). In terms of the implementation of the Finnish curriculum, there exist possibilities to develop cross- and transcurricular climate change education within the local curricula at a municipal level. A transcurricular approach can be realized as an optional thematic course designed locally and collectively by a team of teachers representing several subjects. Alternatively, a crosscurricular approach can be implemented by designing study units that include two to three existing courses from either the local or national curriculum that thematically work together.

Didactical challenges in climate change education

Climate change is a wicked problem and an SSI that appears to be a priority within the Finnish core curriculum for general upper secondary education. However, the topic is distributed as a general topic across the curriculum, which may lead to a lack of clarity and fragmentation. There is a gap between policy and practice in this regard in both Finland and elsewhere, meaning what is recommended by researchers and stated in the curriculum is not necessarily implemented in the classroom (Lambert et al., 2015; Stevenson, 2007). Even if the policy intention is to make all teachers responsible, this may lead to no one taking responsibility. In the Finnish educational system, teachers are free to structure their own teaching. How climate change as an SSI is portrayed and problematized, as well as how climate science literacy develops, are therefore results of teachers' pedagogical and didactical reasoning and decisions. From the split content, teachers may collect the pieces together to shape more complex pictures for students if they are capable and willing to unite subjects. There are also other challenges. For instance, the Finnish core curriculum does not state or describe how scientific literacy should be taught, which is probably also the case in other countries. Another problem concerns how to encourage ethical discussions and the formation of students' worldviews, which are essential elements when working with wicked problems in education and, more generally, with Bildung. In the following paragraphs, we will discuss the didactical challenges connected to climate change education through the didactical questions (what, why, and how) related to the literature reviewed in this chapter. The questions intertwine and overlap in a way that makes them difficult to separate from each other, and consequently, we will discuss them in parallel.

Teachers are key agents in relation to successful crosscurricular climate change education. In Finland, it is usually a teacher with a background in science who teaches geography. According to Zeidler (2014), science teachers experience more challenges when it comes to including ethical perspectives in their teaching. The teachers in this category are more likely to prefer Vision I concerning scientific literacy than Vision II due to their extensive content knowledge and interest (see Chapter 13 for similar observations). The challenges experienced in relation to incorporating other perspectives could also be due to insecurities about leaving the objective science perspective and experiences of curricular overload. By contrast, Zeidler (2014) also refers to a study in which students with a good understanding of science content produced better arguments during an SSI discussion, which led to stronger civic capabilities.

According to Roberts and Bybee (2014), there is a risk that teachers who focus on Vision I use social and personal perspectives and situated-oriented materials as solely a motivational resource, while teachers who focus on Vision II include less science content. Climate change, as an SSI, would benefit from a wider view of science education that prepares students to actively, scientifically, and collectively participate in societal problem-solving (Holbrook et al., 2022). The inclusion of situated or personally engaging material is vital to the development of Vision II and Vision III perspectives as well as climate literacy, although it is not called for by the core curriculum. Course materials can include exercises that focus on ethical questions or local perspectives, but it is up to the individual teacher to allocate lesson time for such perspectives. In addition to presenting science content, Holbrook et al. (2022) propose a trans-contextualization phase that extends students' learning beyond the classroom. Their qualitative study identifies a need for trans-contextualism to prepare students for civic action, although it also highlights challenges on three levels: teacher level, curriculum level, and student level (Holbrook et al., 2022). There is most likely a general need to focus on such didactics in teacher education.

When it comes to the choice between teaching subjects or working crosscurricularly, it is all about hierarchy. According to Ross (2000), crosscurricular subjects have a lower status when compared with core or elective subjects. Moreover, to develop climate change education, teachers' professional ownership and specialization should be promoted (Eilam, 2022). Within the Finnish core curriculum, climate change is included in the sustainability topic and spread across several subjects. Eilam (2022) considers this tendency problematic, since sustainability as a concept remains vague and controversial, while climate change is more clearly defined and scientifically grounded. To promote climate literacy, climate change should be assigned more space and resources within the curriculum (Eilam, 2022). In the Finnish general upper secondary context, this is possible at the local level because the local curriculum is constructed in the municipalities, although it may be more difficult in other education systems.

As mentioned earlier in this chapter, crosscurricularity in general upper secondary education in Finland is implemented in, for example, the form of transversal competences. However, the advantages of crosscurricular teaching might be endangered if crosscurricularity is limited to a competence approach. If the competences rather than the central content of school subjects are in focus, the core content might be neglected (Butt & Lambert, 2014). Crosscurricular issues such as climate change must also be anchored in profound subject knowledge. It is crucial that students develop skills and competences in parallel with subject content. Geographical knowledge provides substance and examples. It also contributes to a deepening of the understanding of various sustainability education-related and climate change education–related themes, including

> population growth and movement; biomes and ecological change; biodiversity and endangered species; energy mining, renewables and post-carbon economies; water security, quality and distribution; weather and climate; food production, distribution and consumption; earth science and geological time scales (and the possibility of the Anthropocene).
> (Lambert, 2013, p. 88)

An alternative way of ensuring crosscurricular teaching regarding climate change involves creating curricular space. Eilam (2022) proposes the establishment of climate change as a "disciplinary-subject": in other words, establishing climate change as a discipline and including climate change in the curriculum as an independent school subject. Eilam bases this argument on several factors but emphasizes both practical and theoretical justifications as well as the lack of empirical evidence for successful crosscurricular approaches to including climate change within the curriculum. However, the content knowledge Eilam (2022) identifies is related to observed changes in the climate, drivers of climate change, the risks and impacts of climate change, the adaptation and mitigation of climate change, socioeconomic factors, policy and governance, and ethics, all of which have been obtained through interdisciplinary research (Eilam, 2022). But climate change as a subject in its own right places high demands on teachers; otherwise, the subject content might remain monocurricular.

Conclusion

It is challenging to integrate school subjects, and a solid content knowledge base is required if teachers of individual subjects are to succeed with such integration. Moreover, pedagogical content knowledge is also required, which poses a challenge for subject teacher education. Since educational studies are limited in terms of time, there is already too much content to cover. Thus, there is no simple way to handle this kind of wicked problem in education. An alternative for teachers is to collaborate with colleagues who teach other subjects and to discuss and plan the teaching together. However, collaboration and transcurricularity may be difficult to achieve for structural reasons such as unsuitable schedules and lack of time (Gullberg, 2022). These factors constrain the aspirations expressed in the curriculum. Yet, young students today participate in school strikes and demonstrations on behalf of the climate. Many are ready to stand up for the future, although to be able to mitigate climate change they need knowledge and tools from both the field of science and society, which should duly be integrated into a broad Bildung perspective (Klafki, 1998; Sjöström & Rydberg, 2018). A Bildung perspective (see Chapter 3) emphasizes the individual's role as part of humanity in the past, the present, and the future, which entails obligations and responsibilities. Therefore, education policy, teachers, and their didactics have to stand up for both students and the climate. Living in a world with climate change, students have the right to Bildung, to become critically engaged in their society, and to develop knowledge-based agency. According to Andersen (2020), Bildung is both freedom and responsibility, independence and interdependence.

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