

## Knowledge Contributions from Different School Subjects to Cross-Curricular Didactics for *Bildung* and Sustainability

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### Abstract

*In the context of humanistic Bildung-centred Didaktik, the educational potential of different school subjects is emphasized. But how can different school subjects collectively contribute to the 'cultivation-of-human-powers' and Bildung with a focus on sustainability? In this article, seven different school subjects are compared. Eleven teacher educators from Malmö University, Sweden, have written scholarly about the roles of their respective school subjects for Bildung and sustainability. Drawing from the texts related to the seven school subjects – geography, mathematics, physical education and health, religious education, science for citizenship, Swedish as a second language, and visual arts – a comparative analysis was conducted. The primary focus was to understand the unique characteristics of each school subject, explore their epistemic differences, and discern their potential roles in fostering cross-curricular didactics for Bildung and sustainability. It is shown that the different school subjects collectively provide complementary contributions to contemporary Bildung and climate change literacy.*

### Keywords

*Educational content, Bildung, sustainability, crosscurricular, comparative subject didactics*

## Introduction

In humanistic *Bildung*-centred *Didaktik* (Klafki, 1998), the educational potential of different school subjects is emphasized (e.g., Deng, 2022; Janik et al., 2024; Ryen & Jøsok, 2023). At the same time, such teaching benefits from being cross-curricular (Klausen & Mård, 2024), as it can be oriented towards grand societal challenges like climate change. Grand societal challenges are comparable to what Klafki (1998) described as epoch-typical key problems. They are also often called ‘wicked problems’ (e.g., Lönngren & Van Poeck, 2021) due to their intricate nature, characteristic of the whole Anthropocene epoch. Gilbert (2016, p. 192) notes that we live in an era where “Everything is now complex – that is, deeply entangled, inter-connected, unpredictable and open. Any given problem has multiple dimensions.”

In this article, we advocate ‘sustainability’ as a future-oriented vision for education, fully aware of the critiques against this concept, especially concerning ‘sustainable development’. We posit that each school subject can uniquely contribute to cross-curricular teaching that promotes *Bildung* and sustainability. As authors and teacher educators, our expertise across seven different school subjects – geography, mathematics, physical education and health, religious education, science for citizenship, Swedish as a second language, and visual arts – ensures comprehensive representation. Initially, we delved into scholarly discussions on the role of our respective school subject for epistemic awareness, *Bildung*, sustainability, and cross-curricular education. A comparative and qualitative analysis, including hermeneutic elements, was conducted. The primary focus was on the epistemic differences among the seven school subjects and their potential epistemic contributions to cross-curricular didactics for *Bildung* and sustainability. In the concluding discussion, we particularly elaborate on the potential contributions of the different school subjects to climate change education.

The purpose of education is a fundamental question (the why-question), where the response influences the content of education (the what-question). Similarly, the selected content impacts the teaching practice (the how-question). In this article, our primary interest lies in better understanding the educational potential of different school subjects and how they can contribute to *Bildung*. Deng (2020, p. 69) posits that *Bildung* consists of three interconnected parts:

understanding worlds, ways of thinking, and capabilities. It encompasses both broad disciplinary knowledge and skills.

*Bildung* is what the individual learner can develop in school and elsewhere in life. The content taught potentially affects the students' education. The content undergoes several transformations, from the national (intended) curriculum via the enacted curriculum to the experienced (Hudson et al., 2023), with the teacher playing a central role. Teachers interpret and implement the curriculum differently, which is crucial for what type of knowledge students will meet and potentially learn (see Örbring, 2021, for an example in geography). The way teachers understand the subject's content and the curriculum affects what and how they teach. The knowledge-potential inherent in a single school subject is referred to by Hudson et al. (2023) as 'subject-specific educational content knowledge'.

School subjects encompass a much broader knowledge base than their corresponding academic discipline(s) (e.g., Deng, 2012; Rothgangel & Vollmer, 2020). Several school subjects have multifaceted knowledge bases. For example, the school subject physical education and health is based on a mix of embodied awareness of movement, health, and nature connectedness (Ekberg, 2021). In all these three content areas, various forms of knowledge are present.

In this article, we pose the following two questions:

- How can we interpret different school subjects (focusing on secondary school level), and what kind of educational content do they offer when compared?
- What potential contributions can they make, from an epistemic perspective, to *Bildung* and cross-curricular didactics oriented towards sustainability issues and grand societal challenges such as climate change?

Over the last decade, there has been a growing interest in comparative subject didactics, as evidenced by various studies (e.g., Hudson et al., 2022; Ligozat et al., 2015; Nygren et al., 2022). With this article, we, as authors representing seven different subject didactics, aim to contribute to comparative subject di-

dactics, mainly about: What constitutes educational content? This work also contributes to discourses within the meta-discipline of ‘general subject didactics’ (e.g., Vollmer, 2021). We suggest that a segment of this latter area can be called ‘cross-curricular didactics’. Didactics which unite different specific subject didactics have also been called ‘transdisciplinary didactics’ (e.g., Janik et al., 2024, p. 7). In this article we primarily address (inter)disciplinary literacies and contemporary *Bildung*.

## Theoretical background

### School subject didactics

‘Didactics’ is not merely an instrumental instructional science but rather a broad humanistic scholarly field for teachers and teacher education that emphasizes the importance of reflective teacher decisions regarding knowledge, worldviews, and values (e.g., Hopmann, 2007; Schneuwly, 2011; Zierer & Seel, 2012). For instance, the professional teacher plays an important role in shaping local and practical curriculum and reflection in practice.

‘School subject didactics’ can be seen as a subdiscipline within teacher education that corresponds to a specific school subject. Different school subjects have distinct subject didactics subdisciplines, but also share many commonalities (e.g., Bayrhuber & Frederking, 2024; Vollmer, 2021). Subject didactics can be considered as an autonomous academic discipline for the teaching profession and teacher education (e.g., Cramer & Schreiber, 2018; Vollmer, 2021). Sjöström (2018a) has highlighted cross-curricular goals and collaboration as an important aspect of school subject didactics.

School subjects and their corresponding academic discipline(s) are fundamentally different (e.g., Deng, 2012; Deng, 2022). As Mård and Klausen (2024, p. 7) state, “Although having their epistemological basis in academic disciplines, school subjects are knowledge domains with their aims and rationales.” Both content and methods differ significantly between the school subjects and corresponding academic discipline(s). All school subjects are “driven by social, political and educational purposes” (Deng, 2022, p. 602), rather than advancing disciplinary knowledge.

Vollmer (2021, p. 143), drawing on a German reference to Baumert, categorizes the following four groups of school subjects based on their different ways of relating to the world: cognitive-instrumental (mathematics, natural sciences), aesthetic-expressive (language/literature, music/fine arts, physical expression), normative-evaluative approaches towards society (history, economic education, politics/social/legal studies), and tackling problems of rationality (religion, philosophy). In other words, school subjects have various ways of relating to the world, leading to different school subject didactics.

### *Bildung*-oriented subject education

In *Bildung*-oriented didactics, content (in a broad sense) is considered fundamental (e.g., Deng, 2022; Klausen & Mård, 2024; Ryen & Jøsok, 2023). Both the concepts of ‘knowledge’ and ‘content’ can be understood broadly, including tacit and embodied elements, historical, social, and moral dimensions, and an objective-material (e.g., Deng, 2020). Additionally, the value dimension is a central part of content in many school subjects (Mitchell & Stones, 2022). *Bildung*-oriented teaching practice centres on the teacher catalysing the students’ meaning-making about relevant content.

*Bildung* is a complex concept with at least five historical elements – biological-organic growth processes/humanism, connection to ancient cultures, spiritual elements, enlightenment thoughts, and emancipation – (e.g., Sjöström & Talanquer, 2018; Sjöström & Tyson, 2022), with its latter mentioned socio-political dimension being the latest addition. Originating in mid-eighteenth-century Germany (Horlacher, 2016), *Bildung* became the general philosophical framework for education, particularly in Germany and Scandinavia. *Bildung* is fundamental for the field of didactics in general (e.g., Hudson, 2016), focusing on developing human powers and potential. This development hinges on a broad understanding of content, the cultivation of critical-democratic values and the capacity to act in an integrated whole. Described more thoroughly and mainly based on von Humbolt (2000), *Bildung* is about “developing learners’ knowledge, skills, and competences”, including “moral virtues and wisdom”; this is based “on connecting the self with the world, on attitudes and values, on integral human formation, and on cultivating the person as a whole” (Jakubik, 2023, pp. 46-47). One aspect of *Bildung* is to develop what can be called epistemic awareness, which fundamentally represents an understanding of one’s

way of knowing (Gardiner, 2020). In a broader sense, it also includes meta-awareness, understanding of other perspectives, and epistemic agency. Although not exactly the same, other terms than *Bildung* have been used with somewhat the same meaning, such as disciplinary literacy, capabilities and knowings (e.g., Yavuzkaya et al., 2022). Below we will also relate to some of these concepts.

In a contemporary understanding of *Bildung*, citizenship is one central aspect, as well as affect and bodily activity (Klausen & Mård, 2024). Some scholars have recently linked the concept of *Bildung* to our existence in the Anthropocene era (e.g., Kvamme, 2021). When explicitly oriented towards ecological awareness, such an orientation can be termed eco-reflexive *Bildung* (e.g., Sjöström, 2018b; Sjöström & Talanquer, 2018). It is intrinsically bound “to the world’s materiality with culture and society as a part” (Yavuzkaya et al., 2022, p. 4). What can be called ‘Powerful Subject-Knowledges’ include embodied and relational dimensions of knowledge (Yavuzkaya et al., 2022). As part of a future-oriented contemporary *Bildung*, we believe it is crucial to emphasize epistemic awareness and agency in addition to more traditional aspects of *Bildung*.

### *Bildung* according to Klafki

Klafki’s theory of categorical *Bildung* provides a framework for understanding educational content (e.g., Deng, 2022). He divided *Bildung* into what can be called material *Bildung* – the objective side – and formal *Bildung* – the subjective side (e.g., Klafki, 1998; Sjöström & Eilks, 2020). In material *Bildung*, the focus is mainly on knowledge products, and in formal *Bildung*, mainly on skills and processes. In categorical *Bildung*, the objective and subjective sides are intertwined. Klafki advocated for selecting content that is fundamental to the discipline, provides essential world experiences and insight, and has exemplary significance to offer a structure for understanding the field of study (Sjöström & Eilks, 2020). While material and formal *Bildung* are integrated in practice, it is useful to discuss them separately for analytical reasons, as Klafki did.

Material *Bildung*, which is primarily about orientation knowledge, can be divided into (1a) a focus on encyclopedic knowledge (educational objectivism) and (1b) moral maturity through cultural consumption (classical *Bildung*) (Andrée & Bladh, 2021, p. 83). Formal *Bildung*, on the other hand, is mainly

about personal development and basic skills. It can be divided into (2a) personal maturity, where “inherent bodily, spiritual and soul forces” (our translation from Swedish), including curiosity and creativity, are expressed (functional *Bildung*), and (2b) (instrumental) methodological skills, such as the ability to read, count, and paint (methodological *Bildung*) (Andrée & Bladh, 2021, p. 83).

### Cross-curricular didactics

Deng (2022, p. 599) describes a knowledge-rich curriculum, which is “*future-oriented* in the sense that it aims at the formation of autonomous and responsible individuals who can thrive and flourish in the present and future world.” Different school subjects can collectively provide complementary contributions to *Bildung* and sustainability (Gericke, 2022). The next and final subsection of this theoretical background will highlight climate change as an especially urgent cross-curricular theme in the Anthropocene era.

The differences between multidisciplinary, interdisciplinary, and transdisciplinary approaches and their defining characteristics have been discussed in several publications (e.g., Helmane & Briska, 2017; Mård & Klausen, 2024). Mård and Klausen (2024, p. 7) suggest ‘crosscurricular teaching’ as an overarching meta-concept, which they briefly explain as “work across different domains”. While such interdisciplinary work presents challenges, it also holds great potential regarding the transfer of knowledge (broadly) among different knowledge domains. This transfer can encompass various elements, including factual knowledge, theories, methods, skills, problem selection, and framework construction (Klausen, 2014).

Many arguments have been proposed for the importance of cross-curricular teaching, such as its role in fostering citizenship, critical thinking, collaborative skills, creativity, preparation for future employment, higher education, and meeting grand societal challenges (Klausen & Mård, 2024). The latter is our primary focus in this article. Recently, Kurup et al. (2023) discussed the importance of ‘interdisciplinary integrated powerful knowledge’ in tackling complex real-world issues and how such interdisciplinary knowledge can be co-created. One step in this co-creation is to “formulate a disciplinary and interdisciplinary knowledge base and practice that incorporates and respects

the traditional aspects while also expanding and enriching them with new perspectives and methods” (Kurup et al., 2023, p. 968). School subjects provide disciplinary and traditional contributions, among other potential contributions. When school subjects intersect in a cross-curricular setting, there is the potential for something new to be formed.

Klausen and Mård (2024) argue for *Bildung* as a theoretical foundation for cross-curricular teaching. They state, “Although *Bildung* calls for teaching across and beyond school subjects, it maintains an important role for teaching particular subjects” (p. 29). Their text mainly describes a classical *Bildung* concept, also connecting to Klafki’s categorical *Bildung* and discussing some characteristics of a contemporary *Bildung* conceptualization.

When considering the subject didactics for a specific school subject, one crucial aspect is the subject’s relationship to cross-curricular goals (Sjöström, 2018a). As previously mentioned, this article focuses on sustainability issues, particularly climate change. Recently, Laugesen and Elf (2024, p. 174) presented an empirically grounded model of sustainability didactics. This model is represented by a triangle, surrounded by the cultural practices of the educational setting. The three corners of the triangle represent contents, forms, and acts. Teaching events are affected by logical, moral, and aesthetic-affective dimensions. In this article, our main interest lies in exploring how the different school subjects can contribute to contemporary *Bildung*.

Cross-curricular interactions inherently bring epistemological similarities and contrasts among different school subjects to the fore. The different school subjects must find ways to cooperate and develop collectively, aiming to weaken the boundaries between them to some extent (Lilliedahl, 2018), while concurrently respecting the specific character of each subject.

### Climate change education

Mitchell and Stones (2022, p. 4) emphasize that “the Anthropocene calls for school education to enable a critical ethical disposition that can respond to the existential, socio-economic and political nature of this epoch”, especially considering the ongoing and pressing climate changes. Much research has been dedicated to climate change education (e.g., Eilam, 2022; Kate et al., 2019;



Sjöblom et al., 2024). For instance, Kate et al. (2019) studied how teacher students from three different school subjects – science, history, and geography – approach cross-curricular teaching on climate change. More recently, Sjöblom et al. (2024) discussed climate change as a complex socio-scientific issue within upper-secondary education. Climate change is described as a wicked problem, and its education is discussed from a cross-curricular teaching perspective. The authors connected it to a broader *Bildung*-perspective and also to a Vision III of scientific/disciplinary literacy (read more about Vision III in e.g. Sjöström & Eilks, 2018). The latter has recently been linked to, for instance, interdisciplinary and transdisciplinary approaches to education (e.g., Kubisch et al., 2022) and future-oriented agency (e.g., Laherto et al., 2023).

## Method

We, a collective of scholars and teacher educators across seven different school subjects, commenced our research by describing and discussing the unique characteristics of our respective school subjects. We utilized the following frame-work as a guide for the writing of the respective seven texts (each ranging from 700 to 1,000 words):

- The historical background and visions of the school subject
- A view of what knowledge (in a broad sense) the students can develop by participating in the teaching of the school subject (e.g. understanding of the world, critical perspectives, subject thinking, disciplinary literacy, subject practices, communication skills, practical-aesthetic expression, agency, etcetera)
- The school subject's potential contribution to 'cross-subject knowledge' (interdisciplinary integrated powerful knowings, for e.g. sustainability, interculturality, critical (media) literacy, climate action, etcetera)?
- The potential contribution of the school subject in a cross-subject and inclusive teaching, such as language and media use (in a broad sense).

The outcome of our writing was one longer text for each of the seven school subjects we collectively represent. Due to limited space in the article, these subject-specific texts and their exclusive references are not published in this journal. However, we aspire to disseminate them publicly elsewhere. Summaries of key sections from each subject text are provided below. In addition, parts of the discussion in this article and linked references are taken from some of the subject texts.

The analysis and discussion were conducted in three steps: (1) The first author conducted a qualitative comparison of the seven subjects, described in the section ‘Comparison of the seven school subjects.’ (2) Based on the subject texts, the first author proposed how a table showing different *Bildung* elements in the different subjects could be constructed; the proposal was then adjusted based on feedback from the respective subject representatives. This part of the analysis is described in the section ‘Contributions of the school subjects to *Bildung*.’ Notably, Table 1 was subjected to a self-critical review by one or two co-authors/representatives for each of the seven school subjects (didactics) included in this study. (3) The role of the different school subjects in cross-curricular teaching oriented towards the grand societal challenge of climate change was considered. This is especially discussed in the final section. All authors commented and contributed, especially to parts about their school subjects. The entire text has been reviewed and approved by all authors.

## About the seven school subjects

Here, we present a concise overview of each of the seven Swedish school subjects, drawing from the more extensive texts written by one or two authors, as indicated in parentheses:

- Geography (in Swedish “geografi”; Per Schubert & David Örbring; the longer text is 759 words excluding references) – is an interdisciplinary subject with great potential to contribute to a holistic perspective to better understand complex sustainability challenges, such as climate change and poverty. Lambert (2011) describes school geography as linking with science, social science, arts, and humanities, enabling students to develop broad knowledge and

skills. It has a spatial and temporal perspective on the Earth's changing environments to understand better people's living conditions and the interaction between man, society, and nature.

- Mathematics (in Swedish “matematik”; Petra Svensson Källberg & Ulrika Ryan; 907 words) – exhibits a dualistic character. On one hand, it can be understood in terms of problem-solving and its relevance to everyday life, including decision-making. Additionally, mathematics is crucial in fostering active participation and citizenship within a democratic society. On the other hand, there is a focus on mathematics itself, emphasizing, for example, mathematical concepts, procedures, and reasoning. Mathematical literacy' enmeshes the individual's capacity to use or apply mathematical knowledge (Jablonka, 2003; Källberg & Ryan, 2022). Over time the focus in mathematics education has shifted from calculus to mathematical competences (Niss & Jensen, 2002).
- Physical Education and Health (in Swedish “idrott och hälsa”; Jan-Eric Ekberg & Marie Larneby; 837 words) – aims to develop versatile movement capability, encourages physical activity in numerous ways, and emphasizes outdoor education. Notably, it is the “only subject in school where ‘body knowledge’ and movement are in focus” (Ekberg, 2016, p. 265). Since the 1994 school reform, the subject has also included ‘health’ to strengthen health as a content knowledge area with a holistic perspective on the body.
- Religious Education (RE) (in Swedish “religionskunskap”; Bodil Liljefors Persson; 768 words) – has changed from focusing on Christianity and biblical history in the early 20th century to a broad school subject consisting of three areas: ethics, life issues (including existential issues), and knowledge of religions' beliefs and traditions (Hartman, 2000). Inclusion, equality, and recognising a plurality of values and norms are central themes.
- Science for citizenship (in Swedish “naturkunskap”; Jesper Sjöström; 860 words) – can be described as studying science within everyday life and societal contexts. Introduced into the Swedish upper-secondary school curriculum in 1970, it caters for students who do not have natural sciences as a major. The subject encom-

passes three key elements: conceptual knowledge, including health and environmental knowledge; nature-of-science-aspects; and science-in-society-aspects, including individual decision-making related to socio-scientific issues.

- Swedish as a Second Language (in Swedish “svenska som andraspråk”; Catarina Economou; 731 words) – extends beyond mere knowledge of the Swedish language. Its purpose is to empower students to strengthen their ‘multilingualism’ and understand its inherent value. While sharing many similarities with the subject Swedish as a Mother Tongue, the focus naturally shifts in second language teaching toward language scaffolding. Although literature reading plays a minor role in Swedish as a Second Language, there is currently an ongoing shift (Economou, 2016) to provide all students with opportunities to gain ‘cultural capital’ and intercultural knowledge.
- Visual Arts (in Swedish “bild”; Ann-Mari Edström & Bjørn Wangen; 806 words). In the beginning drawing skills was in focus. In the early 1900s there was a significant shift towards art, aesthetics, and self-expression. By the late 1960s, the subject was redefined as visual communication, emphasizing a critical, semiotic, and socially oriented perspective. Art was abandoned as the subject’s foundation (Åsén, 2006), yet explorative processes remained an integral part of the subject. There is a growing interest in artistic methods and navigating the uncertainty in contemporary art (cf. Edström & Wangen, 2020).

In the following, we will first compare the seven school subjects and then conclude the article by – based on our comparative analysis – discussing the roles of the school subjects in cross-curricular didactics.

## Comparison of the seven school subjects

The seven school subjects we represent and have outlined each have quite distinctive histories. They have emerged in different ways, but all in correlation

with societal development. In general, it can be said that all the school subjects have been broadened and contextualized over time.

The seven subjects possess quite different characteristics. Geography and science for citizenship are rooted in the natural and social sciences. Visual arts is an aesthetic subject, while Swedish as a second language is linguistic. Physical education and health emphasize the physical aspect of learning. Mathematics, while inherently linked to disciplinary mathematics, extends beyond to include areas such as digitalization, statistics, and complex decision-making. Religious education is a comprehensive subject that explores religions, worldviews, values, and norms (Franck & Liljefors Persson, 2023).

In almost all subjects, there is some type of tension. For example, geography grapples with the dichotomy between its university disciplines – physical and human geography, which are more specialized and systematic – and the school subject, which is more integrative and synthesizing (Bladh, 2020a). Within mathematics as a university discipline, there is a tension between pure mathematics, which is theoretical, and applied mathematics, which relates to knowledge in problem-solving and technological developments in areas such as finance, medicine, climate change, artificial intelligence, etc. Also, there is tension between pure and applied mathematics. Furthermore, there are different perceptions about how socially embedded (sometimes ‘critical’) school mathematics should be. Physical education and health have a dichotomy between their perception as an activity or knowledge subject. It encompasses movement, outdoor education, and health that involves understanding about, in, and through the body. In visual arts, there is a tension between the concepts of art and visual communication.

As teacher educators, we navigate through conceptual tensions daily. The tensions enable discussions on variations in views of knowledge within and between school subjects, curricula, etcetera. These discussions encourage students to think critically and develop their epistemic awareness. Science for citizenship, geography, and religious education contribute to knowledge about the surrounding world, encompassing both natural and cultural aspects. All three subjects address lifestyle-related questions. Both geography and science for citizenship center around the Earth’s environment (complex socio-scientific issues) and have an interdisciplinary character. Science for citizenship has a

basis in biology, physics, geoscience, and chemistry while connecting to technology and society. The school subject essentially involves taking a stand on various health and environmental issues and questions where natural and social science meets. Such an intersection is inherent in the academic discipline of geography, which prominently features spatial and temporal perspectives. Elements of physical education and health, and mathematics, can also be characterized as interdisciplinary. Swedish as a second language focuses on developing students' linguistic capabilities. Language plays a crucial role in cognitive processes, communication, and learning.

Various methods are underscored in the majority of the seven subjects, such as geographical methods in geography and artistic methods in visual arts. Visual arts mainly focuses on the visual aspects but also incorporates spatial, temporal, multimodal, and material aspects. The latter includes embodiment, a central focus in physical education and health.

## Contributions of the school subjects to *Bildung*

Table 1 outlines *Bildung*-categories across the seven school subjects. As shown in the table, all the subjects contain elements of both material and formal *Bildung*, albeit with different degrees of emphasis and focus. The table is divided into six subcategories in total. Three (1a-c) are classified as material *Bildung*, while the other three (2a-c) fall under formal *Bildung*. The subcategories 1a-b and 2a-b, based on Klafki, were described in the theoretical background: (1a) focuses on encyclopedic knowledge (educational objectivism), (1b) focuses on moral maturity through cultural consumption (classical *Bildung*), (2a) focuses on personal maturity in that “inherent bodily, spiritual and soul forces” (our translation from Swedish), including curiosity and creativity, come to expression (functional *Bildung*), and (2b) focuses on (instrumental) methodological skills, such as to be able to read, count, and paint (methodological *Bildung*).

In this article, we have added two additional subcategories (1c and 2c): (1c) holistic understanding of the world, society, and humans, and (2c) attitudes and evaluative abilities, such as critical thinking and action competence. Related to the latter, Mogensen and Schnack (2010, p. 60) have argued that their concept of action competence is “closely linked to democratic, political education and

*Table 1. Bildung-categories in the seven school subjects, where ‘1’ stands for material Bildung and ‘2’ for formal Bildung. The six subcategories are briefly described in the text. X=central dimension of the school subject, and x=elements of it in the school subject. The table also shows where disciplinary literacies of the different school subjects have their focuses: GL=Geographical Literacy; ML=Mathematical Literacy; PH=Physical Literacy; HL=Health Literacy; RL=Religious Literacy; SL=Scientific Literacy; FL=Fundamental (language) Literacy; CL=Cultural Literacy; and AL=Arts Literacy.*

<b>Bildung dimension/ School subject</b>	<b>Material Bildung</b>			<b>Formal Bildung</b>		
	1a encyclopedic knowledge	1b classical culture	1c holistic (world)view	2a embodied knowledge	2b skills and methods	2c attitudes and evaluative abilities
Geography	X		X GL		x	X
Mathematics		x		x	X ML	X
Physical education and health			x HL	X	X PL	X
Religious Education (RE)	x		X RL	x		X
Science for citizenship	X		X SL, HL		x	X
Swedish as a second language		X CL		x	X FL	X
Visual arts		x CL		X	X AL	X

to [...] the notion of ‘Bildung’.” For a contemporary conceptualization of action competence, see e.g., Sass et al. (2020).

In short, the six subcategories can be characterized as concerning the following: 1a=educational objectivism or encyclopedic knowledge; 1b=classical Bildung, which concerns classical culture; 1c=holistic understanding/(world)

view; 2a=functional *Bildung*, which concerns embodied knowledge; 2b=methodical *Bildung*, which concerns skills and methods; and 2c=attitudes and evaluative abilities, such as critical thinking and action competence.

As can be seen in Table 1, each of the seven subjects incorporates elements of both basic *Bildung* categories (1 and 2), albeit with different weights and focuses. In the table, we have marked a large 'X' when the *Bildung* subcategory is a central dimension of the school subject and a small 'x' when it is an element. For each of our seven subjects, we have ticked a total of four out of six (sub) categories. However, in many cases where we did not mark a cross, one could make a case for the presence of a certain element from these subcategories in the corresponding school subject.

Although the focus for the school subjects is usually either on material or formal *Bildung*, all the subjects incorporate elements of both. Geography, science for citizenship, and religious education place an emphasis on material *Bildung*. On the other hand, visual arts, mathematics, and Swedish as a second language, have an emphasis on formal *Bildung*. However, these subjects also incorporate elements of material *Bildung*. For example, language subjects deal with media products such as literature and film; and mathematics includes, among other things, elements of cultural history. Similarly, geography, natural science subjects, and religious education contain elements of formal *Bildung*. For example, ethical approaches are important in religious education, while action competence is a key component in science for citizenship.

The subject physical education and health contains elements of both formal and material *Bildung*. On the one hand much of the movement content is primarily supporting formal *Bildung*. A central focus in the school subject is on embodiment. Learning involves understanding the body by using the body. On the other hand a significant portion of the health content is supporting material *Bildung*. This knowledge about health-related topics has similarities to subjects such as geography and science for citizenship. Simplistically, one can say that geography, science for citizenship, and religious education, as well as the health content of physical education and health, focus on holistic understanding. In contrast, visual arts, mathematics, and Swedish as a second language, and particularly the movement aspects of physical education and health, emphasize skills development.



While all school subjects, at least to some extent, experience a tension between the two basic *Bildung* categories, material and formal, we believe it is most pronounced in physical education and health. In this school subject, encyclopedic knowledge (1a) not only provides content but also bolsters the functional (2a) and methodological and instrumental skills (2b), and vice versa. The components are so closely intertwined that distinguishing between them is difficult. This difficulty in placing physical education and health as either primarily formal or material *Bildung* is a challenge for the subject in practice. It is not uncommon for students to perceive the subject almost exclusively as formal *Bildung* (2a), a ‘doing’, while other aspects of *Bildung* are perceived as subordinate, or sometimes even as unnecessary.

Worth noting in Table 1 is that all of our seven subjects – as they are described in this article – have a large “X” for the (sub)category 2c. We posit that all of our subjects contribute to attitudes and evaluative abilities, such as critical thinking and action competence. For example, in visual arts, pupils are encouraged to critically reflect, communicate, and actively participate in society. Similarly, the subject of physical education and health contributes to the overarching aim of education, which is the development of human agency and the ‘cultivation-of-human-powers’.

### Capabilities, competences, and similar concepts

Many different terms have been used to describe individuals’ ‘knowings’ (broadly), such as capabilities and competences. Klausen and Mård (2024) argue that much of the concept ‘competence’ is reasonably consistent with *Bildung*.

The extended subject texts include capabilities, competences, disciplinary literacy, and ‘disciplinary thinking’. For instance, the geography text employs GeoCapabilities (e.g., Bladh, 2020b). The mathematics text highlights ‘mathematical competences’ and ‘mathematical literacy’. In the text on religious education, ‘religious competence’ is mentioned, and the text on visual arts refers to ‘visual competence’. The ‘science for citizenship’-text highlights different visions of ‘scientific literacy’ (e.g., Sjöström & Eilks, 2018). In addition to focusing on fundamental literacy, Swedish as a second language also highlights its contribution to the students’ ‘cultural capital’. Several subjects relate to ‘critical

literacy’ and highlight ‘disciplinary thinking’. Examples of the latter include ‘mathematical thinking’ and ‘geographical thinking’. Furthermore, the concept of ‘knowings’, which is related to Klafki’s categorical *Bildung* (Carlgren, 2020; Yavuzkaya et al., 2022), is highlighted by several school subjects.

Regarding disciplinary literacy (Shanahan & Shanahan, 2012), Table 1 also provides insights into the focal points of disciplinary literacies across the different school subjects. In the table, we have included a number of disciplinary literacies that were not used in the more extensive subject texts, such as ‘geographical literacy’ and ‘arts literacy’. However, in the context of aesthetic subjects in general, the concept of literacy is seldom used. In visual arts, the term ‘visual literacy’ has sometimes been used; but today – as was shown in the extended text on that school subject – broader concepts such as ‘visual competence’, which lack strong linguistic connotations, are preferred.

## The role of different school subjects in cross-curricular didactics for *Bildung* and sustainability, especially focusing the climate challenges

In summary it can be concluded that the seven different school subjects collectively provide complementary contributions to contemporary *Bildung*. We believe they all play important roles in cross-curricular didactics for sustainability. In this final section, we will briefly elaborate on the role of the subjects in cross-curricular teaching, using the climate challenges as an example. The research area dealing with this is called climate change education. Tytler and White (2023, p. 39) state that “Climate change education calls for an interdisciplinary consideration of climate science as well as the social implications and initiatives for change.”

Both geography and science for citizenship are largely interdisciplinary in themselves and simultaneously oriented towards socio-scientific issues, with climate change serving as a prime example. Especially these two school subjects have a great potential to contribute to a holistic perspective (though not as much to functional (2a) and classical (1b) *Bildung*-perspectives), and to support understanding of complex issues related to climate change. A spatio-temporal perspective, which is fundamental to geography, is essential for understanding

climate change and its impacts. In practice, project work on climate actions can be used as a way of orienting the teaching towards critical literacy of a Vision III type (Fuchs, 2023). By using the three visions-framework for teaching about climate change, scientific and societal aspects as well as socio-political actions could be captured: the Conceptual Literacy Vision I ensure understanding of the Earth's systems, the Contextual Literacy Vision II enable exploration of the human impact in the systems, and the Critical Literacy Vision III introduces project work on climate actions (Fuchs, 2023).

All the other school subjects that we represent also offer important contributions to climate change education. In the school subject physical education and health, climate issues are present, particularly in sections oriented towards outdoor education and nature connectedness. Language subjects, such as Swedish as second language, can provide insights into life in the Anthropocene through fiction and literature (e.g., Hoydis et al., 2023). These insights can include the challenges posed by climate change and the potential impacts it may have on living conditions in different parts of the world in the future. Furthermore, language competence is necessary in political discussions and argumentation about climate issues. Mathematics can be used as a powerful tool to describe and predict the world, for example the consequences of climate change (e.g., Steffensen et al., 2023). Central to mathematics are modeling and problem-solving, which can be seen as a form of action competence when mathematics is used to understand and act in the world. Religious education contributes with worldview and ethics perspectives. Finally, but not least, the subject visual arts is central both for its departure from modernist ideals and its contributions to spatial visualizing, in particular. The subject's ability to manage open processes is also important (cf. Ingold, 2019). Visual arts is probably one of the seven subjects that most clearly embraces 'open-ended processes' and uncertainty, which characterizes our human age, the Anthropocene. This open-endedness can be seen as a kind of action competence in the Anthropocene. The other school subjects contribute to action competence and *Bildung* with their unique knowledge sets (in a broad sense).

Collectively, the different school subjects contribute to *Bildung* and sustainability. They can all, with their different disciplinary literacy, contribute to what has been called 'climate change literacy' (Hoydis et al., 2023).

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