

# Powerful knowledge, transformations and *Didaktik*/curriculum thinking

Zongyi Deng<sup>\*</sup> 

*University College London, UK*

From the vantage point of knowledge transformations entailed in curriculum making, this article seeks to contribute to a rethinking of the concept of powerful knowledge. It makes a case for linking the teaching of content knowledge to the development of human powers (understanding, ways of thinking, capabilities and dispositions) by way of knowledge transformations. The article starts by examining three perspectives or contributions to knowledge transformations: (1) Bernstein's *recontextualisation*; (2) Chevallard's *didactic transposition*; and (3) Gericke *et al.*'s *transformations*. This is followed by a discussion of what transformations entail from the perspective of *Bildung*-centred *Didaktik*, and what transformations mean in today's context if education is centrally concerned with the development of human powers. It concludes by questioning the conflation of powerful knowledge with disciplinary knowledge.

**Keywords:** curriculum making; curriculum thinking; transformation; *Bildung*-centred *Didaktik*; knowledge; content; competences

## Introduction

Over the last two decades, there has been a global movement towards delineating the central purpose of education in terms of twenty-first-century competences (Hopmann, 2008; Karseth & Sivesind, 2010). Behind the movement is a *competence discourse* which posits a set of competences (abilities, skills, dispositions) individuals need to acquire in order to effectively participate in the knowledge society (Biesta & Priestley, 2013; Willbergh, 2016). Among those competences are collaboration, communication, creativity, critical thinking, problem solving and ICT literacy (Voogt & Roblin, 2012). To promote the integration of twenty-first-century competences in the school curriculum, international organisations like the European Union, OECD and UNESCO have developed competency frameworks that provide specific descriptions of competences and recommendations on learning environments, pedagogical strategies and assessment approaches (Partnership for 21st Century Learning, 2016; OECD, 2005; Binkley *et al.*, 2012). This has led to a global rise of competence-based approaches to the curriculum, together with an embrace of constructivist learning theory and learner-centred pedagogy that are believed to enable young people to

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<sup>\*</sup>UCL Institute of Education, University College London, 20 Bedford Way, London WC1H 0AL, UK. Email: zongyi.deng@ucl.ac.uk

develop twenty-first-century competences (Anderson-Levitt, 2017; Tahirsylaj & Sundberg, 2020).<sup>1</sup>

The competence discourse has been subject to criticisms. *Competence* is an *economical* rather than an *educational* concept, which finds its origin in the field of human resources management.<sup>2</sup> Associated with the concept is human capital theory, which conceives the central task of education as providing skills and knowledge that make the individual employable and economically productive (see Biesta & Priestley, 2013; Labaree, 2014; Willbergh, 2016). Missing in the discourse are broader, more important questions of what it means to be an autonomous individual in his or her own right and what capabilities or powers he or she needs to develop in a democratic society (see Biesta, 2017; also Willbergh, 2016). Furthermore, the competence discourse eschews formalised curriculum making—centred on the selection and organisation of knowledge content—in favour of competence-based approaches to the curriculum (Karseth & Sivesind, 2010). It severely undermines the role and significance of knowledge in education, curriculum and classroom teaching (Young & Muller, 2010).

In direct opposition to the competence discourse, Michael F. D. Young and his colleagues advance a social realist approach to curriculum (Young & Muller, 2013; Young, 2013; Young *et al.*, 2014). Based on the sociological works of Émile Durkheim and Basil Bernstein, Young differentiates between academic, disciplinary and everyday knowledge. Disciplinary knowledge is *powerful* because it is objective, reliable, fallible and testable, and because it provides the best understanding of the natural and social worlds. The acquisition of this knowledge allows students to acquire the powers of knowledge—in terms of moving beyond their particular experience, envisaging alternative and new possibilities, and participating in social and political debates (Young & Muller, 2013; Young, 2013). This concept of powerful knowledge is held as a curriculum principle, according to which the central purpose of the curriculum is to help students acquire disciplinary knowledge that they cannot acquire at home (see Young *et al.*, 2014; also Young, 2009). Furthermore, access to this knowledge is an entitlement of *all* students.

As the ‘best way to organise the knowledge-led curriculum’, a school subject, Young and his colleagues believe, results from ‘recontextualising’ its parent academic discipline (Bernstein, 1990, 2000) (i.e. selecting, sequencing and pacing academic knowledge in view of the ‘coherence’ of the discipline and constraints created by the developmental stages of students; Young, 2013). Schools are to develop their own curricula through interpreting the national curriculum, with powerful knowledge as the most important resource. Teachers are to promote epistemic access to disciplinary knowledge and to take students beyond their existing experience or what they already know (Young, 2013; Young *et al.*, 2014).

The social realist school has been influential in ‘bringing knowledge back’ into the current global discourse on curriculum policy, curriculum development and classroom practice.<sup>3</sup> Their approach to the curriculum can be seen as an alternative to the pervasive competence discourse in the sense that the curriculum centred on helping students acquire powerful knowledge can lead them to possess *powers* (as noted above)—an alternative term to *competences*. In fact, it has long been argued that disciplinary knowledge is an embodiment of human wisdom, ways of thinking and

dispositions of the mind (Dewey, 1966; Shulman & Quinlan, 1996). It therefore provides an important resource for the development of human powers (understanding, ways of thinking, capabilities, dispositions), which can encompass many of those twenty-first-century competences—communication, logical reasoning, critical thinking, imagination and creativity, among others (Carlgren, 2005; Willbergh, 2016; Deng, 2020). The key is to *transform* disciplinary knowledge into educational purposes, into the institutional curriculum and into classroom teaching in ways that are conducive to the development of human powers (Deng, 2020). However, knowledge transformations as such have not received sufficient attention from Young and his colleagues (see Nordgren, 2017; Gericke *et al.*, 2018).

This article seeks to contribute to a rethinking of the concept of powerful knowledge in view of knowledge transformations associated with curriculum making across the societal, institutional and classroom arenas (to be further explained in the next section). It makes a case for linking the teaching of content knowledge with the development of human powers by way of knowledge transformations. To start with, I will examine three perspectives or contributions to knowledge transformations: (1) Bernstein's *recontextualisation*; (2) Chevallard's *didactic transposition*; and (3) Gericke *et al.*'s *transformations*. The first two are major perspectives which have been widely employed in the literature for discussing issues concerning knowledge transformations in curriculum planning, curriculum development and classroom teaching (e.g. Tiberghien *et al.*, 2009; Chevallard & Bosch, 2014; Dowling, 2020). In the third contribution, Gericke and his colleagues articulate a conception of knowledge transformations, and on the basis of which they argue for an expansion of the concept of powerful knowledge (Gericke *et al.*, 2018). This article can be seen as a continuation of their work.

In what follows I will examine what knowledge transformations entail across the societal, institutional and classroom domains from the perspective of *Bildung*-centred *Didaktik*—the primary theoretical resource of this article. *Bildung*-centred *Didaktik*, as indicated in Klafki (1959), results from *uniting* material *Bildung* (focusing on the acquisition of knowledge) and formal *Bildung* (focusing on the development of human potential) theories in a dialectic, reciprocal manner.<sup>4</sup> With this distinction in hand, the social realist approach can be seen as a kind of material *Bildung* theory that prioritises knowledge over general capabilities or competences. The competence discourse, in contrast, can be seen as a kind of formal *Bildung* theory that eschews knowledge in favour of generic competences (see Willbergh, 2016). *Bildung*-centred *Didaktik*, as will be seen, provides a powerful way of thinking about how to bring together the teaching of knowledge and the development of human powers or capabilities in today's world, by way of knowledge transformations.

I will conclude by questioning the conflation of powerful knowledge with disciplinary knowledge. As will be argued, powerful knowledge needs to be rethought in light of the three knowledge transformations entailed in curriculum making, with a central concern for the development of human powers. Powerful knowledge takes on different meanings, forms and manifestations as knowledge is *transformed* into educational purposes, into the institutional curriculum and into instructional events and tasks. These three transformations call for three kinds of *Didaktik*/curriculum thinking directed towards: (1) conceiving the role and substance of knowledge for the

development of human powers; (2) interpreting or theorising content (knowledge selected into the institutional curriculum) in view of educational potential and realisation; and (3) unlocking and actualising the educational potential of content—through identifying elemental elements and unpacking their educational meanings and significance—in the classroom.

### Three perspectives or contributions to transformation

#### *Bernstein's recontextualisation*

As noted earlier, in the work of Young and his colleagues, knowledge transformation is conceived in terms of recontextualisation (Bernstein, 1990, 2000)—selecting, sequencing and pacing academic knowledge in the curriculum. To understand Bernstein's *recontextualisation* more adequately, it is necessary to examine his theory of the pedagogic device in which the concept is extensively used. Framed within the tradition of sociology, the pedagogic device deals with recontextualisation processes which knowledge undergoes to become knowledge in the curriculum and then knowledge taught in the classroom (Bernstein, 1990, 2000). Through these processes, knowledge is *transformed* in the sense that it 'has changed its position in relation to other texts, practices and positions', 'has been modified by selection, simplification, condensation, and elaboration' and 'has been repositioned and refocused' (Bernstein, 2000, p. 87). The pedagogic device provides a complex theoretical framework for analysing the recontextualisation processes and how the processes relate to broader issues of social reproduction and inequality (Singh, 2002).

The framework stipulates three sets of rules—*distributive*, *recontextualising* and *evaluative*—that regulate how knowledge is delocated from the field of production (e.g. the academic discipline) and relocated to the field of recontextualisation (the curriculum) and to the field of reproduction (the classroom). Distributive rules define and distribute access to different knowledges—what knowledges are distributed to whom—reflecting the extant power relations of the society. Recontextualisation rules regulate the dislocation of knowledges from the production field and their relocation in the curriculum. This process is carried out by agents in the official recontextualising field (policymakers and administrators, among others) and the pedagogic recontextualising field (teacher educators, textbook authors and so forth) (Bernstein, 1990, 2000; Singh, 2002). It is achieved through the 'embedding' of a regulative discourse (the values and social order on which curriculum and pedagogy are based) and an instructional discourse (selection, sequencing and pacing) (Bernstein, 2000; Moore, 2013). Evaluative rules 'are concerned with recognising what counts as valid acquisition of instructional [curricular content] and regulative [social conduct, character and manner] texts' (Singh, 2002, p. 573; Bernstein, 2000). These three sets of rules are hierarchically related, reflecting power relationships (Singh, 2002).

This brief exposition of the pedagogic device brings to light two processes of knowledge transformation—one pertaining to the institutional curriculum (the recontextualisation field) and the other to classroom teaching (the reproduction field). Both transformations are *social* and *political* in the sense that they are controlled by social agents and educational professionals and regulated by principles and broad societal

configurations of power. In addition, they are *epistemic* because of constraints posed by knowledge structures in the academic disciplines from which knowledge derives. Bernstein (2000) distinguished between hierarchical and horizontal knowledge structures,<sup>5</sup> and suggested that ‘knowledge should be recontextualised in accordance with the structures of its underpinning conceptual system’ (Hordern, 2017, p. 197). The pedagogic device, together with other Bernsteinian concepts such as codes, regions, singulars and generic, functions to explain how knowledge transformations at the institutional and classroom levels contribute to the (re)production of social inequality and power relation (Singh, 2002).

### *Chevallard’s didactic transposition* (transposition didactique)

Whereas Bernstein is concerned with social and political issues surrounding knowledge transformations, Yves Chevallard, a French mathematics educator, is concerned with the epistemological and cultural constraints created by transformations on mathematics teaching. The concept of didactic transposition (*transposition didactique*) arises from the need to understand the relationship and differences between knowledge in places of production and in other places—the institutional curriculum, schools and classrooms. Didactic transposition, broadly defined, refers to ‘the transformations an object or a body of knowledge undergoes from the moment it is produced, put into use, selected, and designed to be taught until it is actually taught in a given educational institution’ (see Chevallard & Bosch, 2014, p 170; also Chevallard, 1985).

In mathematics education the concept is employed to describe the processes of the transposition of scholarly knowledge (‘reference knowledge’) into knowledge in the curriculum (‘knowledge to be taught’) and then into classroom forms (‘taught knowledge’). The first transposition is undertaken by agents in the ‘noosphere’—politicians, policymakers and curriculum developers—responsible for the development of the institutional curriculum in the form of policy documents, syllabuses and textbooks (Bosch & Gascón, 2006; Chevallard & Bosch, 2014). Upon transposition, knowledge in the curriculum takes on a different meaning than scholarly knowledge; the former is used for educative purposes and the latter for research purposes. The second transposition is carried out by teachers through interpreting and enacting what is contained in the curriculum within their specific classroom contexts. Taught knowledge takes on different forms than in the curriculum (knowledge to be taught) because of its adaptation into classroom situations (Bosch & Gascón, 2006; Chevallard & Bosch, 2014).

With the concept of didactic transposition, Chevallard brings to the fore the need to investigate knowledge transformations that occur outside and beyond classrooms. Those transformations inevitably create epistemological and cultural constraints on mathematics teaching. After all, what is taught in classrooms ‘is originated in other institutions, constructed in concrete practices, and organised in particular sets of objects’ (Chevallard & Bosch, 2014, p. 170). Accordingly, Chevallard calls for an expansion of the ‘unit of analysis’ to include ‘phenomena related to the school reconstruction of mathematics’ (Bosch & Gascón, 2006, p. 54). The anthropological theory of didactics (ATD), a later development of didactic transposition, is developed to

investigate the conditions and constraints on classroom teaching imposed by transposition processes associated with knowledge production and diffusion in society—processes that are fundamentally *anthropological* in nature (Chevallard, 1992, 1999).

#### *Gericke et al.'s transformations*

Like Chevallard, Gericke and his colleagues are concerned with the different meanings knowledge takes as it undergoes transformations inside and outside a school system—processes which, they argue, have not been adequately taken into consideration by Young and his colleagues. In their attempt to expand the concept of powerful knowledge, they articulate a three-faceted conception of transformation which is informed by the German/Nordic tradition of didactics, didactic transposition, ATD and Bernstein's recontextualisation (Gericke *et al.*, 2018).

Transformation is defined as 'an integrative process in which content knowledge is transformed into knowledge that is taught and learned through various transformation processes that take place outside and within the educational system' (p. 432). Three transformations—which take place at the societal, institutional and classroom levels—are identified, together with three related sets of contextual factors that influence the ways in which powerful knowledge needs to be understood.

- At the societal level, what knowledge is considered as powerful is influenced by social and cultural expectations and demands that shape what is to be taught in school, including the need for developing twenty-first-century competences; the need to tackle multidisciplinary topics and themes such as migration, interculturality and sustainability; and the need to cope with technological changes, among others.
- At the institutional level, what counts as powerful knowledge needs to be understood in view of the transposition from knowledge produced in academic disciplines into knowledge in the institutional curriculum. What knowledge is regarded as 'powerful' is determined by institutional factors such as the purpose of schooling, institutions (universities, industries, ministries, schools) and their relationships, and actors in those institutions, among others.
- At the classroom level, what knowledge is regarded as powerful needs to be investigated in light of the interpretation and enactment of an institutional curriculum by a teacher and, to some extent, students. The interpretation and enactment are influenced by institutional and cultural factors such as 'governance and policy', 'traditions of teaching' and the 'public view of the subject'. (pp. 433–437)

On the basis of this articulation, they argue for an expansion of the concept of powerful knowledge that takes account of the transformations knowledge needs to undergo at the three levels noted above. Furthermore, they call for empirical studies on teachers' and students' understanding of the content to be taught so as to identify and discern powerful knowledge in the classroom.

#### *Transformations, powerful knowledge and curriculum making*

The examination of the three perspectives or contributions shows that knowledge transformations occur outside and inside schools and classrooms, which are

associated with the complex processes of curriculum planning, curriculum development and classroom enactment. The processes are accomplished by a multiplicity of agents and practitioners in various locales and are governed by diverse sets of demands, norms and assumptions or beliefs. Knowledge takes on different meanings and forms in those various sites in which the curriculum is ‘made’. In congruence with Gericke *et al.* (2018), three transformations can be identified, which are entailed in three distinctive arenas of curriculum making, the *societal* (educational policy discourse and debates over what should be taught in schools), the *institutional* (the selection and organisation of what is to be taught) and the *classroom* (instructional events and tasks that represent curriculum enactment) (Doyle, 1992, 2008; Westbury, 2000).

I now question the proposition of powerful knowledge as a curriculum principle. With an exclusive focus on curriculum making in schools and classrooms, the proposition tends to overlook the undertakings of curriculum making at the societal and institutional levels, which are prior to, and independent of, the work of teachers. In the classroom, what a teacher primarily works with is the content in the curriculum (‘knowledge to be taught’), rather than the knowledge in the academic discipline as such (see Deng, 2007; Deng & Luke, 2008). There is hence a need to rethink the concept of powerful knowledge in view of knowledge transformations in the societal, institutional and classroom arenas. In this connection, Gericke and his colleagues rightfully argue that ‘powerful knowledge cannot be identified based on the discipline alone, but needs to consider transformation processes and be empirically explored’ (Gericke *et al.*, 2018, p. 428).

Building on the work of Gericke *et al.*, I seek to contribute to a rethinking of powerful knowledge in view of the transformation processes entailed in curriculum making—across the societal, institutional and classroom arenas—using *Bildung*-centred *Didaktik* as the primary theoretical resource. *Bildung*-centred *Didaktik* is designed to shift away from a concentration on mere access to knowledge—the preoccupation of Young and his colleagues—towards a focus on the cultivation of human powers by means of knowledge. Furthermore, as will be illustrated in what follows, *Didaktik* provides a distinctive form of theorising directed towards the development of models and frameworks for *making* the curriculum (curriculum planning, curriculum enactment or classroom teaching), rather than merely explaining the curriculum. *Didaktik* theorists regard *knowledge transformation* in its own right and theorise it from a perspective ‘internal’ to curriculum making. Or, in the words of Biesta (2012), they treat transformations as processes that ‘exist in and through the interpretations’ of those involved in the practice of curriculum making. This is rather different from the form of theorising—particularly manifested in the works of Bernstein and Chevallard—directed towards the development of models and frameworks for *explaining* curriculum and curriculum making. Transformations are simply ‘there’ to be investigated (Biesta, 2012), with a form of theorising that is ‘external’ to curriculum making and so only illustrates issues of transformation from the outside.

### **Knowledge transformations in *Bildung*-centred *Didaktik***

German *Didaktik* provides a body of thinking about teaching and learning embedded in the institutional context of schooling which, as many have observed (e.g. Westbury,

2000; Hudson, 2002, 2016; Lambert, 2018), is ‘virtually unknown’ in the English-speaking world. Yet it can ‘highlight some very important, and universal, educational questions that are not well-articulated in the English-language curriculum tradition’ (Hudson, 2002, p. 44). *Didaktik*, which can go far back to ancient times (Plato: Meno), was formally established around the 1800s in Germany, with significant influences from Comenius, Herbart, Schleiermacher and many others (Hopmann, 2007). Sparked by the rise of state-based curriculum making and teacher education, the development of *Didaktik* was inextricably connected with the implementation of mass schooling in Germany during the late nineteenth and early twentieth century. *Didaktik* shows how to construct state curriculum guidelines and how to translate the guidelines into classroom teaching (Hopmann & Riquarts, 1995; Hopmann, 2007). Among many branches or schools, *Bildung*-centred *Didaktik*, established in the 1950s primarily by Wolfgang Klafki, has had an enduring impact on classroom practice and teacher education in Continental Europe (Gundem, 2000).

Theorising in *Didaktik* is animated by and directed towards a normative vision of education (i.e. *Bildung*). Moreover, theorising is eminently practical in the sense that it is directed towards the development of practice—rather than merely an understanding or explanation of practice—through the development of models and frameworks that lend support to school practitioners. Three transformations can be identified, pertaining to the concept of *Bildung*, the task of selecting and organising content in the state curriculum guideline (the *Lehrplan*), and teaching as the meeting between the teacher, students and content within the institutional context of schooling and the *Lehrplan*.

According to Humboldt, *Bildung* refers to the full formation of the individual through the development of intellectual and moral capabilities, the cultivation of sensibility, self-awareness, liberty and freedom, and dignity (see Lüth, 2000; von Humboldt, 2000; also Hopmann, 2007). This understanding is expanded by Klafki (1998) to include the development of self-determination (autonomy), co-determination (participation) and solidarity (also see Horlacher, 2015). *Bildung* is achieved through linking the self to the world in ‘the most general, most animated and most unrestrained interplay’ (von Humboldt, 2000, p. 58). The individual seeks to ‘grasp as much [of the] world as possible’ and to make a contribution to humankind through developing his or her own unique potential (von Humboldt, 2000). The world, independent of human thinking and practice, is processed by different forms of human thought, represented by various academic disciplines (humanities and sciences) and specialised fields (Lüth, 2000).

With *Bildung* as a point of departure, *Didaktik* theorists (re)conceive the role and substance of knowledge; that is, they *transform* knowledge for *Bildung*. A conception or theory of knowledge is established in which knowledge is seen as an indispensable resource for developing human powers (understanding, capabilities, dispositions) and, therefore, must be ‘used in the service of intellectual and moral *Bildung*’ (Lüth, 2000, p. 77). *Bildung* is achieved through interactions with several forms of knowledge—social, historical, physical, geographical, religious and aesthetic—each of which provides access to an aspect of the world and has unique potential for developing human powers (Lüth, 2000; Roth, 2000). Accordingly, the role of knowledge includes:



- A means of expressing, exercising and intuiting powers.
- A potential stimulus for human development.
- A counterpart to mark out the boundaries of the individual.
- A means of objectivizing ideas and powers in order to leave traces in the world. (Lüth, 2000, p. 77)

On this account, knowledge is *powerful* because of its potential contribution to *Bildung*, that is, to the development of human powers. Powerful knowledge thus takes on an educational meaning from the perspective of *Bildung*. The contribution to *Bildung* consists in the *substance* of knowledge to be introduced below.

The second transformation, closely related to the first one, is entailed in curriculum making at the institutional level, which deals with how knowledge is selected and organised into the content contained in the state curriculum guideline, the *Lehrplan*. Powerful knowledge takes the form of content (or subject matter) in the institutional curriculum—a special kind of knowledge which has been *transformed* from the perspective of *Bildung* and for teaching and learning in the classroom. The transformation is underpinned by a *Didaktik* way of interpreting or theorising content—or a theory of content (*Theorie der Bildungsinhalte*)—that forges a link between students' encounter with content and *Bildung*. This theory consists of four interrelated concepts: *contents of education (Bildungsinhalt)*; *educational substance (Bildungsgehalt)*; *the elemental (das Elementare)*; and *the fundamental (das Fundamentale)*.

As the stuff in the curriculum, the contents of education result from a deliberative process of selection and organisation of the wealth of academic knowledge, experience and wisdom for *Bildung*. Contents, set aside for teaching, are *potentially powerful* in terms of their contribution to *Bildung*:

... these contents, once the children or adolescents have internalized and thus acquired them, would enable them to 'produce a certain order' (Litt) in themselves and at the same time in their relation to the world, to 'assume responsibility' (Weniger), and to cope with the requirements of life, and take the free chances of life. The contents of teaching and learning will represent such order, or possibilities for such order, such responsibilities. . . (Klafki, 2000, p. 150)

The potential or power of content is found in its educational substance (*Bildungsgehalt*):

Within the whole of the contents to be acquired there is the essential and the inessential, fruit and leaves, the interior and the exterior. As the learners process the matter, differences emerge. . . There are different degrees of internalization of what is presented: some matter penetrates through to the roots of inner growth, the rest remains peripheral. From among the whole of an object of instruction, we distinguish its educational substance (*Bildungsgehalt*) and comprehend the latter as those elements of the former where the subject matter can begin to take root and to be internalized, and on whose retention the value of the learning and the practising essentially depends. . . Teach in such a way that what is given is learned. . . and that its substance (*Bildungsgehalt*) can take effect. (Willmann, 1957; cited in Klafki, 2000, p. 147)

In other words, by virtue of its educational substance, content can bring about a *fundamental* change in the perspectives, capabilities, dispositions and ways of being-in-the-world of the individual (Krüger, 2008). The educational substance of content

is comprised by the *elemental* elements (concepts, principles, relations, values, methods). The theory of content can thus also be referred to as the theory of categorical *Bildung*, according to which *Bildung* is achieved through a ‘dialectical unity’ of the elemental and the fundamental, entailing a ‘double unlocking’ (see Willbergh, 2016; also Klafki, 1959), as will be explained below.

Informed by *Bildung* and its related theory of content, the state curriculum guideline (*Lehrplan*) only lays out school subjects and their contents. It does not specify educational substance, meaning and significance (Hopmann, 2007). Teachers are entrusted with a high level of professional autonomy to interpret the state curriculum guideline. ‘The essence of what is expressed conceptually in the *Lehrplan* and institutionalized in the organisational structure’, Weniger (2000) argued, ‘requires the educator to come alive, and thus curricula are directed primarily at the teacher’ (p. 120).

The third transformation, in connection with the second, is necessitated by curriculum making in the classroom where a teacher interprets and translates the content in the curriculum guideline into events and tasks that bring about ‘fruitful’ encounters between students and content. The interpretation and translation call for *Didaktik* thinking directed towards unlocking and actualising the educational potential of content. Informed by a theory of content, the teacher identifies the elemental elements (substance) of content and unpacks its educational meaning and significance in terms of *Bildung*, with particular students in mind and within a particular historical context (present and future) (Klafki, 2000). Moreover, the teacher searches for exemplary forms (narratives, dramas, stories), which can be embodiments of educational substance. Teaching can be characterised in terms of a double unlocking. By means of exemplary forms, the teacher unlocks the educational potential of content for students. Likewise, the student opens up or unlocks himself or herself for what is unlocked or disclosed. In other words, teaching ‘opens up a world for the student, thus opening the student for the world’ (see Hopmann, 2007, p. 115; also Klafki, 2000).

### **Human powers, knowledge transformations and *Didaktik*/curriculum thinking**

The preceding discussion on *Bildung*-centred *Didaktik* brings to light three transformations of knowledge pertaining to *Bildung*, the institutional curriculum and the work of teachers in the classroom. I now turn to discuss what these three transformations mean in today’s context—if education is centrally concerned with the development of human powers—and unpack the implications for rethinking powerful knowledge. The three transformations, as will be shown, call for *Didaktik*/curriculum thinking across the societal or policy, institutional and classroom arenas. The term *Didaktik*/curriculum is used because of significant convergence between *Bildung*-centred *Didaktik* and Schwabian curriculum thinking (see Deng, 2020, 2021)—the latter of which will be invoked below.

At the outset, there is a need for a vision of education centrally concerned with the development of human powers that can overcome the problems inherent in the current discourse on twenty-first-century competences noted earlier. To some extent, this vision is found in the capabilities approach of Amartya Sen and Martha

Nussbaum and its application to school geography by David Lambert. According to Sen and Nussbaum, the central aim of education is human development and flourishing through the expansion of human capabilities (Nussbaum & Sen, 1993; Sen, 1985; Nussbaum, 2000, 2013). The term *capabilities*, which can also be referred to as *powers*, denotes what people can actually be and do, including ‘the different combinations of human functionings that can be achieved by people, groups, or both’ (Lambert *et al.*, 2015, p. 724). Applying this approach to school geography, Lambert has developed the *GeoCapabilities approach* that explores and realises the distinctive contribution of geography as a school subject to human development through the development of GeoCapabilities, which include an ability to ‘think about themselves in the world, and about the changing relationship human beings have with the environment’ and a disposition to take ‘environmental and global responsibility’, among others (Lambert & Solem, 2017, p. 8). GeoCapabilities are fundamentally different from twenty-first-century competences; the former are developed through an engagement with powerful disciplinary knowledge with an emphasis on learning to ‘think geographically’, whereas the latter are generic and free-floating, independent of knowledge content (see Lambert *et al.*, 2015). In addition to geography, the capabilities approach of Sen and Nussbaum has also been applied to other school subjects in attempts to bridge the general goal of developing capabilities and subject goals (e.g. Martins, 2017; Choo, 2018; Markle, 2019). The development of capabilities, as many argue, is inextricably connected with the ‘pedagogic rights’ of young people to individual enhancement, social inclusion and political participation (Walker & Unterhalter, 2007; Boni & Walker, 2013; Lambert, 2014).

The capabilities approach, together with its application to school subjects, embodies a vision of education that is akin to *Bildung*, indicated in the commitment to the promotion of human well-being and agency through the development of powers by means of curriculum content (see Andresen *et al.*, 2008). The vision can be enriched by the incorporation of the concern in *Bildung*-centred *Didaktik* for the formation of autonomous, self-determined and responsible individuals with fully developed human powers. Among these powers are self-awareness, ‘ethically reflected action’, ‘autonomous thinking’, imagination and creativity, which equip him or her to face the demands and challenges of a future that ‘in principle was not knowable’ (Uljen & Ylimaki, 2017, p. 82). Powers are developed through interactions with various branches of human knowledge, ‘with the social and political situation, with technical achievements, cultural artifacts, and so on’ (Jank, 2014, p. 116). A well-informed, defensible vision of education can inform our understanding of what significance and value knowledge has in our current social and cultural context, of how knowledge selected and organised into curriculum content, and of how curriculum content is interpreted and enacted in the classroom.

The first transformation, at the societal or policy level, occurs when knowledge is ‘transposed’ into the context of educational (policy) discourse, with a central concern for the development of human powers. The transformation calls for *Didaktik/curriculum thinking* that (re)conceives knowledge in terms of the substance and contribution to the development of human powers. To some extent, this way of thinking is found in the recent work of Maude (2017), who (re)interpreted and applied the concept of powerful knowledge to school geography. Apart from the characteristics (objectivity,

reliability, fallibility, testability) that make knowledge powerful, he calls attention to the *powers* that powerful knowledge can afford to students who possess it—in terms of being able to:

- Discover new ways of thinking.
- Better explain and understand the natural and social worlds.
- Think about alternative futures and what they could do to influence them.
- Have some power over their own knowledge.
- Be able to engage in current debates of significance.
- Go beyond the limits of their personal experience. (Maude, 2017, p. 30)

These powers, which can be developed through ‘learning to think geographically’, signify the distinctive contributions geography can make to ‘the development of human potential and well-being both as individuals and as members of a society’ (Lambert *et al.*, 2015).

Maude further identified five types of powerful geographical knowledge that can contribute to the development of these powers or capabilities:

- Knowledge that provides students with ‘new ways of thinking about the world’.
- Knowledge that provides students with powerful ways of analysing, explaining and understanding.
- Knowledge that gives students some power over their own geographical knowledge.
- Knowledge that enables young people to follow and participate in debates on significant local, national and global issues.
- Knowledge of the world. (pp. 181–183)

Powerful geographical knowledge thus takes on educational meaning and significance in terms of contributions to human powers. The contribution consists, as indicated below, in a body of key geographical concepts, which are embodiments of geographical ways of knowing, constituting the substance of geographical knowledge.

This kind of *Didaktik*/curriculum thinking can be further elucidated by looking at the conceptualisation of the essence and role of academic disciplines—notably developed by McKeon and Schwab during the collegiate curriculum reform (1930s–1950s) at the University of Chicago. While the conceptualisation has been introduced elsewhere (Deng, 2018, 2020), I revisit it because it remains highly relevant and instructive for our thinking about how knowledge can contribute to the development of human powers in today’s context. The reform was animated by a vision of liberal education centred on the cultivation of a set of human powers—such as ‘syntactic communication’, an ability to ‘deliberate wisely about technologies based on science’ and ‘to choose thoughtfully among several technological methods’—that allow individuals to confront the challenges in their times (Levine, 2006, p. 119). Informed by this vision, McKeon (1949, p. 295) distinguished three distinct types of academic discipline—natural sciences, social sciences and humanities—in terms of three distinct sets of arts or methods (adapted to three kinds of problems) which determine the role or contribution of academic disciplines in education:

The place of the natural sciences in general education is determined by the arts and skills required to analyse problems, validate knowledge, and formulate or understand statements about natures and things. . . The place of the social sciences in general education is determined by the arts and skills required to analyse problems, validate knowledge, and formulate or understand statements about associations, communities, and institutions set up by men to achieve common values. . . The place of the humanities in general education is determined by the arts and skills required to analyse problems, validate knowledge, and formulate or understand statements about the appreciation and use of the great achievements of man. All three of these arts are applicable to all subject matters. . .

Each of these arts ‘was conceived as manifesting distinctive human powers’ (Levine, 2006, p. 99).

Based on McKeon, Schwab argues that each of the academic disciplines consists of not only statements/conclusions but also the arts of disciplinary enquiry, a mastery of which would allow the development of human powers applicable to wide-ranging situations—political, social, economic, scientific and technological. Schwab (1978, p. 125) stated:

The ‘intellectual’ arts and skills with which the liberal education curriculum is concerned are not then intellectual as to subject matter, and thus exclusive of other subject matters, but intellectual as to quality. They are the arts and skills which confer cogency upon situations and actions whether these be scientific, social, or humanistic, general and abstract or particular and concrete. The liberal arts, however formulated, are to be understood as the best statement of our present knowledge of the human make, of various means – some special in their application to specific subject matters, some general – by which the understanding frees us from submission to impressions, beliefs, and impulses, to give us critical and organizing power and deliberative command over choice and action. A liberal curriculum is one concerned that its students develop such powers.

In other words, the substance of disciplinary knowledge is found in the arts or methods of enquiry in the academic discipline, when the development of human powers is a central concern. It is worth pointing out that Schwab’s exposition of the significance of arts or methods of enquiry in education is also informed by John Dewey. According to Dewey, scientific methods have liberating powers because they allow us to be capable of ‘getting at the significance or our everyday experience of the world’ and provide us with ‘a working pattern of the way in which and the conditions under which experiences are used to lead ever onward and outward’ (Dewey, 1998, pp. 111–122).

In short, the first transformation is driven by the concern for the contribution or value knowledge has for the development of human powers. It calls for a kind of *Didaktik/curriculum thinking* that (re)conceives the role and substance of knowledge in a way that is productive of the development. As a result, knowledge obtains (new) educational meanings and significance. Knowledge is powerful *less* because of the epistemic characteristics (objectivity, reliability, fallibility, verifiability) and *more* because of the contribution knowledge can make to the development of human powers. Therefore, it is reasonable to argue that powerful knowledge should not be confined to only specialised, disciplinary knowledge produced by scholarly communities. Other forms of knowledge—technological, practical, experiential, aesthetic, etc.—can be *powerful* as far as they can contribute to the development (see Carlgren, 2020; also

Schwab, 1969; Deng & Luke, 2008). The challenge for us is to identify those knowledge forms and conceive them for the development of human powers in our times.

The second transformation, at the institutional level, is entailed in the task of selecting and organising knowledge into the content of the curriculum. This task cannot be reduced to merely that of arranging, sequencing and pacing knowledge in light of the constraints imposed by the academic discipline and students. The criteria for knowledge selection and organisation are not residing in the academic discipline, but deriving from a vision of education (as noted above) and its realisation in the classroom. After being selected and organised into the curriculum, knowledge becomes *content* or *subject matter* which takes on educational and curriculum or *Didaktik* meanings. The transformation calls for *Didaktik*/curriculum thinking which links students' encounters with content to the development of human powers. To posit such a link is to interpret or theorise content, purporting a theory of content—concerning what content is, what educational potential content has and how the potential can be disclosed and actualised in the classroom (Doyle, 1992, 2008).

To some extent, this theory is found in Maude's (2020) discussion on how knowledge in the academic discipline is recontextualised into the content of school geography. Four key concepts—*place, space, environment* and *interconnections*—are identified (and selected), which are believed to have immense potential for developing human powers. They provide 'ways of thinking about the world, prompts to the questions to ask about this world, guides to the conduct of an inquiry or investigation, and frameworks for analysis and explanation' (p. 3). These concepts are further divided into several secondary concepts—*interdependence, spatial interaction, processes, flows* and *systems*. Furthermore, each of the concepts is 'disaggregated' into a number of 'second-level', 'increasingly abstract' generations that call for 'factual studies' which progressively lead students to higher levels of thinking and more sophisticated ways of knowing.<sup>6</sup> This body of key and secondary concepts, together with their disaggregations or decompositions, constitutes a theory of content that can inform the selection and organisation of content in a way that supports the development of those human powers noted above.

A more sophisticated theory of content—which includes not only disciplinary ways of knowing but also methods of enquiry—is provided by Schwab (1973), which is a translation of the aforementioned theory of knowledge into curriculum planning and classroom teaching. As the stuff included in the curriculum, content takes the form of scholarly material—scientific reports, historical documents, literary work—which records the process of original enquiry rather than 'rhetoric of conclusion' (Schwab, 1962). To unlock the educational potential (possibilities or opportunities for developing human powers), curriculum developers analyse a particular piece of material by means of three interpretive categories or *faces* of content:

- The first face is the *purport* conveyed by scholarly material (e.g. an historical account of a past event, a moral dilemma or an image of a person or society by a piece of literature, or a way of classifying a group of natural phenomena by a scientific report). For students, understanding the purport can give rise to the broadening of knowledge horizon, transformation of perspectives, cultivation of moral sensitivity and so forth.

- The second face concerns the *originating discipline* from which scholarly material derives, standing for a coherent way of inquiry—a problem formulated, an investigation carried out, the data or argument sought and a conclusion reached. Having students understand and experience the problem, method, principle and conclusion of a particular inquiry allows them to develop independence in thinking, an ability to judge the reliability of knowledge claims and an understanding of the merits and limitations of a particular mode of inquiry.
- The third face concerns certain *access disciplines* that need to be brought to bear on scholarly material to reveal its full complexity and sophistication. A particular piece of material is scrutinised in terms of different types of questions, different perspectives and different methods of inquiry from various disciplines. In other words, it is subject to treatment in a variety of ways and according to a variety of methods. As such, the material renders diverse opportunities for the cultivation of critical thinking, freedom of thought, self-understanding and prudent thought and action. (Deng, 2020, pp. 51–52; also see Schwab, 1973)

The above notion of content and the three faces constitute a theory of content that can inform the selection and organisation of content in ways that maximise the potential for developing human powers. In curriculum planning, all potential pieces of scholarly material (for selection) are analysed in terms of the three faces for educational potential. Whether a piece of material is included is based upon the decision made with reference to its educational potential and in view of the four curriculum commonplaces—the subject matter (content), the learner, the teacher and the milieu (Schwab, 1973). Overall, this theory of content lends support to issues-based, cross-disciplinary approaches to curriculum planning and classroom teaching that, many argue, are more pertinent to the cultivation of human powers (see Westbury & Wilkof, 1978; Klafki, 2000; Levine, 2006).

In view of the above discussion, a school subject cannot be merely a ‘recontextualisation’ of its parent academic discipline as seen by social realists. A school subject, after all, is ‘a uniquely purpose-built educational enterprise, designed with and through educational imagination towards educative ends’ (Deng & Luke, 2008, p. 83). A school subject can be an academic subject (physics, mathematics, history, geography) in which the selection and organisation of content is centred on key concepts which, identified in view of educational and pedagogical purposes, can be significantly different from the key ideas in the discipline.<sup>7</sup> It can also be an interdisciplinary subject (e.g. environmental studies), which is formulated around a set of significant contemporary issues, the solution to which requires bringing to bear concepts and methods from multiple academic disciplines and various sources (see Jensen, 2004; Deng, 2009).

The third transformation, at the classroom level, takes place when a teacher interprets and translates the content in the institutional curriculum into instructional events and tasks which can render multiple opportunities for students to develop human powers. The interpretation and translation, which constitute the core of curriculum making in the classroom, call for *Didaktik/curriculum thinking* directed towards unlocking the potential of content for the development of human powers. Informed by a theory of content, the teacher analyses the content in terms of

elemental elements (educational substance) and interprets or unpacks the educational meanings and significance of content in a classroom context. This can be illustrated by the use of Schwab's theory of content in classroom teaching. A teacher analyses content (scholarly material) in terms of the meaning conveyed (the purport), the particular way of enquiry involved (the originating discipline) and multiple ways of enquiry brought forth (access disciplines) which could be brought to bear on the material. By means of these three elemental elements, he or she makes the content open up manifold opportunities for challenging the understanding of students and cultivating their intellectual and moral powers and dispositions (Schwab, 1969). The success of unlocking the potential of content also depends on a careful analysis of the characteristics of students, who are seen as unique individuals with eros ('the energy of wanting') and as instruments that the teacher needs to make use of (Schwab, 1978).

This kind of *Didaktik*/curriculum thinking can further be illustrated by looking at Klafki's model of lesson preparation directed towards designing opportunities for students to make fruitful encounters with the content in the school curriculum. Based on the theory of content noted earlier, Klafki (2000, pp. 151–157) formulated a five-step set of questions that serves to facilitate teachers' *Didaktik*/curriculum thinking directed towards unlocking the educational potential of a piece of content in a classroom context:

1. What wider or general sense or reality does this content exemplify and open up to the learner? What basic phenomenon or fundamental principle, what law, criterion, problem, method, technique, or attitude can be grasped by dealing with this content as an 'example'?
2. What significance does the content in question, or the experience, knowledge, ability, or skill, to be acquired through this topic, already possess in the minds of the children in my class? What significance should it have from a pedagogical point of view?
3. What constitutes the topic's significance for the children's future?
4. How is the content structured (which has been placed in a specifically pedagogical perspective by questions 1, 2, and 3)?
5. What are the special cases, phenomena, situations, experiments, persons, elements of aesthetic experience, and so forth, in terms of which the structure of the content in question can become interesting, stimulating, approachable, conceivable, or vivid for children of the stage of development of this class?

Questions 1, 2 and 3 are directed towards identifying the elemental elements (of the content) and unpacking the educational meaning and significance of those essential elements. These questions go beyond a teacher's understanding or comprehension of the content. They require the teacher to make 'connections with the deepest objective substance of the cultural asset' (Vásquez-Levy, 2002, p. 122) in view of who students are (past, present, future) and to unlock the potential for developing human powers. Questions 4 and 5 are geared to searching for means of realising the potential in terms of content structure and pedagogical representations.

In other words, when the development of human powers is held as the central purpose of classroom teaching, the most fundamental questions are not 'What should I teach?' and 'In what ways is this knowledge powerful?' (Young *et al.*, 2014) but what constitutes the educational potential of content and how the potential can be



unlocked for students to develop human powers. There is no doubt that a teacher needs to have knowledge of the parent academic discipline. However, the fundamental task is *not* that of helping students acquire disciplinary knowledge, but that of using disciplinary knowledge as a tool or resource to create powerful, transformative experiences in the classroom that can lead to the cultivation of human powers.

## Conclusion

This article is a contribution to the rethinking of the concept of powerful knowledge from the vantage point of knowledge transformations entailed in curriculum making, with a central concern for the development of human powers. It makes a case for linking the development of human powers with the teaching of content by way of knowledge transformations. First, I have examined three perspectives or contributions on knowledge transformations: (1) Bernstein's *recontextualisation*; (2) Chevallard's *didactic transposition*; and (3) Gericke *et al.*'s *transformations*. Second, I have analysed what transformations entail from the perspective of *Bildung*-centred *Didaktik*. Third, I have discussed what transformations entail in the current context when education is directed towards the development of human powers and unpack the implications for rethinking powerful knowledge.

In conclusion, I question the conflation of powerful knowledge with disciplinary knowledge. I argue that the concept of powerful knowledge needs to be rethought in light of three transformations entailed in curriculum making across the societal, institutional and classroom arenas, with a central concern for the development of human powers. Powerful knowledge takes on different meanings and forms as knowledge is (re)conceived for educational purposes, selected and organised into the institutional curriculum, and interpreted and translated into instructional events and tasks. The three transformations call for three kinds of *Didaktik*/curriculum thinking, characterised by: (1) (re)conceiving the role and substance of knowledge for the development of human powers; (2) interpreting or theorising content (knowledge selected into the curriculum) in terms of educational potential and its realisation in the classroom; and (3) unlocking the educational potential of content (through identifying elemental elements and unpacking their educational meanings and significance) to bring about opportunities for developing human powers.

In view of this, *Didaktik*/curriculum questions worth pursuing are not just what powerful knowledge is, how disciplinary knowledge is selected, sequenced and paced in the curriculum in view of the constraints imposed by an academic discipline and students, and how students are supported to acquire powerful knowledge. We need to engage with more fundamental questions, such as: What contribution would knowledge make to the development of human powers? How would knowledge be (re)conceived in a way that is productive of the development? How would knowledge be selected and organised into the content of the curriculum in support of the unlocking and actualisation of the educational potential of content in the classroom? How would content be analysed and unpacked by a teacher in ways that open up manifold opportunities for students to develop human powers?

I have tackled these questions by invoking *Bildung*-centred *Didaktik* which, as indicated earlier, provides a distinctive form of theorising that examines transformations

from an ‘internal’ perspective and is directed towards the development of frameworks and models for *making* the curriculum. Let us not forget that curriculum making, as revealed in the earlier discussion of the contributions of Bernstein, Chevallard and Gericke *et al.*, is embedded in a broad social, cultural and institutional context and influenced by diverse sets of political, social and cultural demands, expectations, norms and beliefs. Apart from the *Didaktik*/curriculum questions noted above, there are complex political, social and cultural questions which call for a form of theorising that is ‘external’ to curriculum making and illustrates issues of transformation from the outside. In this regard, the contributions of Bernstein, Chevallard and Gericke *et al.* are particularly pertinent for a more sophisticated, more responsible and ethical understanding of knowledge transformations. Such an understanding is much needed if we are to develop models and frameworks which can provide support and guidance for curriculum making in a defensible, better-informed manner.

What I have sought to bring to the fore is, after all, a form of theorising which is distinctively educational and *Didaktik* or curricular, directed towards the development of models and frameworks for *making* the curriculum. How might this form of theorising be defended amongst diverse political, social and cultural demands and expectations—in particular, amongst the current demands and expectations centred on preparing students for life and work in the twenty-first century characterised by increasingly globalised transnational economies, intensified international competition, rapid technological development, uncertainties and change? This question can be tackled by adopting a *non-affirmative position* (Benner, 1991; Uljens, 2002) which, also implicit in *Bildung*-centred *Didaktik*, is developed in Germany and Nordic countries. To secure the autonomy of *Didaktik*/curriculum theorising, *Didaktik* theorists argue that education needs to be seen in ‘non-hierarchical relations to politics, culture and economy’ (Uljens & Ylimaki, 2017, p. 38). It is neither ‘superordinate’ nor ‘subordinate’ to political, social and economic demands and expectations. The implication is that *Didaktik* scholars, curriculum theorists and educational researchers need to engage with—but not affirm or yield to—current political and economic demands and expectations. They are to come up with defensible ‘educational solutions’ by reconstructing the central propositions of *Didaktik* in a way that can speak to those expectations and demands. As an educational concept, *Bildung* can ‘address the needs of young generations of the 21st century to think critically, constantly evolve and be creative and imaginative’ (Willbergh, 2016, p. 345). It can be extended to include many of those twenty-first-century competences such as communication, problem solving, critical thinking, innovation and creativity (Carlgren, 2005; Willbergh, 2016). The development of human powers can be achieved through ‘fruitful’ meetings between students and content broadly construed, made possible by innovative approaches to curriculum planning and classroom teaching.

Three challenges for *Didaktik* scholars, curriculum theorists and educational researchers are then in order. The first is to identify knowledge (from academic disciplines and other sources) that can contribute to the development of human powers and to discern the substance of knowledge that makes the contribution possible. The second challenge is to select and organise knowledge into curriculum content in ways that facilitate and support ‘fruitful’ encounters of students with content in the classroom, orchestrated by a teacher. The third challenge is to develop models and

frameworks which can provide teachers with guidelines and support in their effort to analyse and unlock the potential of content to bring about manifold opportunities for students to cultivate powers or capabilities.

This article only represents an initial attempt to tackle these challenges. More work is needed to explore more fully how the teaching of knowledge and the development of human powers can be brought together through knowledge transformations. Nevertheless, attempts would not be effective or fruitful without being informed by empirical research. We need to engage with and be informed by pertinent empirical studies into the complexity of curriculum making at the societal, institutional and classroom levels. In particular, we need to engage with and be informed by empirical studies on how curriculum planning and classroom teaching can be directed towards the development of human powers. I hope that more related empirical studies will be available which can illuminate, refine and validate the theoretical propositions made in this article—concerning knowledge transformations, *Didaktik/curriculum thinking* and the development of human powers.

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### Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

### NOTES

<sup>1</sup> It is important to note that competence-based education is widespread but not global. It is mostly prevalent in Europe, South Africa, Australia and New Zealand, but not in the USA or UK (Anderson-Levitt, 2017).

<sup>2</sup> The term has also been heavily shaped by the European framework of key competences for lifelong learning and the OECD's Definition and Selection of Competencies (DeSeCo) project.

<sup>3</sup> There has been a 'knowledge-turn' in the recent development of the national curriculum in the UK and South Africa (Lambert, 2011; Hoadley, 2015). The development contributes to a revival of the discussion of the 'knowledge-driven' curriculum informed by social realism (e.g. McEneaney, 2015; Nordgren, 2017). There is also an emergence of a body of literature examining the role of disciplinary knowledge in educational policy, curriculum and classroom practice from social realist perspectives (e.g. Barrett & Rita, 2014; Young *et al.*, 2014; Barrett *et al.*, 2017).

<sup>4</sup> For a detailed explanation, see Krüger (2008), Frederik (2014) and Willbergh (2016).

<sup>5</sup> Hierarchical knowledge structures are typified in natural sciences where theories and concepts 'build cumulatively and progressively, with earlier formulations being subsumed by later formulations'. Horizontal knowledge structures, in contrast, are exemplified by social sciences and humanities where 'the internal relations – theories and relations between sets of concepts – accrue not by one subsuming the other, but by the addition of parallel theories (languages, or sets of concepts)' (Young & Muller, 2013, p. 239).

<sup>6</sup> For example, the concept of environment is decomposed into nine generations (from simple to complex): (1) 'Climate is the average types of weather, including seasonal variations, experienced by a place over a long period of time'; (2) 'The spatial pattern of world climates identifies ways of explaining their characteristics'; (3) 'Climate has a major influence on the vegetation, soils, water resources and agriculture of places'; (4) 'Climate has an influence on human activities, but the extent of this influence, and how much it can be modified by

technology and human organisation, is contested'; (5) 'Human actions are changing the global climate, but differently in different places'; (6) 'Seasons describe the average weather for different periods of the year, but different cultures describe the seasons differently, using different criteria'; (7) 'Human actions are changing the biophysical environment, in both positive and negative ways'; (8) 'The biophysical environment supports human life, influences human activities, and is being changed by human actions'; (9) 'Weather can be described by temperature, rainfall, wind and sunshine'.

<sup>7</sup> Deng (2007) demonstrates that 'the key ideas in secondary-school physics are different in theory-type, analogue, and representation from their counterparts in the academic discipline of physics' (p. 518). He argues further that there are epistemological, sociocultural, psychological and pedagogical concerns which account for the differences. Maude (2020) points out that key ideas in school geography can be selected based on philosophical, political, sociological, humanistic, feminist and ethical concerns, in addition to academic, disciplinary concerns.

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