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Trajectories of powerful knowledge and epistemic quality: analysing the transformations from disciplines across school subjects

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ABSTRACT
This paper outlines the development of a comparative research framework in subject didactics and applies this in the process of analysing the transformations from academic disciplines across different school subjects. The theoretical framework builds on the concepts of ‘powerful knowledge’ and ‘transformation’ and ‘epistemic quality’ within which transformation processes from the classroom to the societal level are considered as ‘trajectories of powerful knowledge and epistemic quality’. The framework is used to analyse the findings from recent empirical studies across school subjects that have been reported on in publications arising from the Knowledge and Quality across School Subjects and Teacher Education (KOSS) network. The paper then focuses on analysing the transformations from disciplines across school subjects, given that the first boundary in defining powerful knowledge concerns knowledge that is specialized in both how it is produced and transmitted. To analyse this boundary, the findings from the empirical studies are grouped into broad subject categories. These are then compared with the corresponding disciplines by using the widely cited Biglan classification scheme of academic disciplines in higher education. Finally, we consider the implications for curriculum planning and teacher education policy and reflect on the concept of subject-specific educational content knowledge (SSECK).

1. Introduction
The aim of this paper is twofold, involving both a theoretical and an empirical contribution. First, it outlines the development of a comparative research framework for the analysis of learning and teaching within studies in subject didactics. Second, it analyses the transformations from academic disciplines across different school subjects. In doing so, it draws on the results of several recent empirical studies across a range of school subjects that have been reported on in publications arising from the Knowledge and Quality across School Subjects and Teacher Education (KOSS) network (Hudson et al., 2022a, 2022b). Each was concerned to differing degrees with questions related to the nature of powerful knowledge and epistemic quality, the ways in which the associated transformation processes could be described and the implications for teacher education policy and practice. A key point of departure for this development has been to problematize the normative aspect of schooling, which treats school subjects as taken for granted (Goodson & Marsh, 1996). The theoretical

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development is based on the integration of perspectives from the different traditions of curriculum studies and subject didactics. In considering the ways in which we can compare across different school subjects, we focus on the relation between these subjects and their parent academic disciplines.

The theoretical dimension of this paper builds on that outlined in Gericke et al. (2018) which initiated this line of discussion through an exploration of the concept of powerful knowledge (Young, 2009, 2013) that derives from the tradition of curriculum studies. In our initial discussion the concept of powerful knowledge is considered in relation to theories and frameworks developed within the European research tradition of subject didactics. Moreover, the need for empirical studies across school subjects was highlighted at that time (Gericke et al., 2018). The concept of ‘transformation’ is central to this framework which is defined as an integrative process in which the content knowledge is transformed into knowledge that is taught and learned through various transformation processes. This is considered with reference to the Anthropological Theory of Didactics (ATD) and is seen as being related to the intended, enacted and experienced curriculum. These aspects are discussed further in the sections that follow. In our subsequent work (Gericke et al., 2022a; Olin-Scheller et al., 2018), we expanded our theoretical framework by drawing on the tradition of subject didactics to include a focus on the concept of ‘epistemic quality’ (Hudson et al., 2022a; Hudson, 2018). This is defined as the quality of the subject knowledge in question based on an analysis of the relations within the didactic triad. It is a significant aspect of the didactical interaction in relation to what teachers teach and what students come to know, make sense of and can do regarding the content knowledge of the school subject in question. Epistemic quality is seen as a way of articulating aspects of what we mean by powerful knowledge at the classroom level. Our framework also draws on key concepts from Joint Action Theory in Didactics (JATD) (Santini et al., 2018; Sensevy et al., 2005, 2008; Sensevy, 2011) for the analysis of the didactical interaction between teachers and students. We draw on the ideas of ‘epistemic games’ and ‘learning games’ as ‘language games’ (Wittgenstein, 1997) specific to didactic systems. In the process of comparing across school subjects we consider the transformation processes between the societal and classroom levels as ‘trajectories of powerful knowledge and epistemic quality’ by relating to the concept of ‘epistemic ascent’ (Winch, 2013). These aspects are also discussed further in the sections that follow.

In the following sections of the paper, we focus on analysing the transformations from disciplines across different school subjects, given that the first boundary in defining powerful knowledge concerns knowledge that is specialized in both how it is produced and transmitted. To analyse the boundary across school subjects, the findings from the empirical studies are grouped into broad subject categories. These are then compared with the corresponding disciplines by drawing on the Biglan classification scheme of academic disciplines in higher education (Biglan, 1973) which according to Simpson (2017) is probably the most cited organizational system of academic disciplines in higher education.

Finally, we consider the implications for teacher education policy and practice by reflecting on the nature of teachers’ ‘powerful professional knowledge’ (Furlong & Whitty, 2017) and discuss what we see as the significance of ‘subject-specific educational content knowledge’ (SSECK).

2. Theoretical framework

2.1. Powerful knowledge

As discussed in Gericke et al. (2022a) development of the concept of powerful knowledge may be seen in part as a response to critics such as Goodson and Marsh (1996), who argue that curriculum theory had failed to address the historical and political dimensions of change in the latter decades of the twentieth century. They argue that the concern of most curriculum specialists has simply been
on how to implement policy changes, how to train teachers or how to develop pedagogic content knowledge. This position is seen as too often simply playing the part of the facilitator of political will. The failure to study school subjects historically and sociologically is seen to have resulted in school subjects becoming a normative aspect of schooling and treated as ‘taken for granted givens’ (ibid, p1). In contrast, however, they draw attention to the way in which the study of school subjects can rapidly lead to appreciating them as ‘the most quintessential of social and political constructions’ (ibid, p1). From this perspective, school subjects are viewed as social constructions that intersect with patterns of social relations and social structure and are ‘intimately implicated’ (ibid, p1) in their reproduction and in cultural transmission processes.

The concept of powerful knowledge (Young, 2013) is based on two key characteristics, which are expressed in the form of boundaries. The first boundary is that between disciplines and school subjects, which concerns knowledge that is specialized in both how it is produced and transmitted. This specialization is expressed in terms of the boundaries between disciplines and school subjects that serve to define their focus and objects of study. The second characteristic is that this knowledge is differentiated from the experiences pupils bring to school or which older learners bring to college or university. In turn, it is argued that this differentiation is expressed in the conceptual boundaries between school and everyday knowledge.

In their more recent work, Muller and Young (2019) gave greater recognition to the importance of power in powerful knowledge than in previous work. They identify two ways in which power has been understood and used in the literature on powerful knowledge, and a third way that would be possible to argue for. The first way is denoted as ‘power and academic disciplines’ in which power may be seen in the light of the generalizable power of specialized disciplinary knowledge, in comparison to context-dependent concepts. The second way is ‘power and the school curriculum’ and relates to how powerful knowledge is sequenced and paced in the curriculum in a way that represents a systemic recontextualization of the discipline, that is, of a powerful curriculum. Third, they identify ‘power as a generative aspect’ involving the capacity to generate new ideas as a possible way to understand power in powerful knowledge. In this third way to understand power, they look at powerful knowledge following its transformation and describe it as a latent capacity of the student.

Regarding powerful knowledge as a curriculum principle, Young (2015) outlines a ‘Three Futures’ model. This is based on the identification of two main traditions or approaches in recent debates about knowledge that are extrapolated as trajectories into possible futures (Young & Muller, 2010). In the first tradition, denoted Future 1, knowledge is underpinned by an ‘under-socialized’ epistemology and defined as fixed sets of verifiable propositions or concepts that in teaching are evaluated through standardized testing. The second tradition, denoted Future 2, arose as a response to the first, and it is argued that the epistemology of knowledge is ‘over-socialized’ in that the character of knowledge is reduced to ‘who knows’ and the identification of knowers and their practices. Both these approaches are viewed as deficient by Young (2015). It is argued that Future 1 has been shown to be unable to motivate and engage students with the body of knowledge to be learnt and does not provide students with knowledge to tackle complex problems of society today. The alternative approach, Future 2, suggests integration of school subjects, promoting generic skills at the expense of knowledge. As a response to these deficient ways of organizing and investigating curriculum, Young and Muller (2010, p. 14) take a social realist perspective that ‘sees knowledge as involving sets of systematically related concepts and methods for their empirical exploration and the increasingly specialized and historically located “communities of enquirers”’. Young (2015) denotes this alternative approach as a Future 3 scenario. In his most recent work, Deng (2022, p. 4) discusses this model in relation to his discussion concerning the idea of a ‘knowledge-rich curriculum’. He draws attention to Future 3 being characterized by a knowledge-led curriculum directed towards providing all students access to disciplinary knowledge.
2.2. Transformation processes

As indicated earlier, the concept of ‘transformation’ is central to this framework and is defined as an integrative process in which the content knowledge is transformed into knowledge that is taught and learned through various transformation processes. In our initial discussion (Gericke et al., 2018), we emphasize the way in which the concept transformation is understood in somewhat broader terms than it is framed in the framework of ‘pedagogical content knowledge’ (PCK) by Shulman (1987). We argue that instead of simply considering transformation as something that is all about ‘how’ a certain teaching content is to be represented in the classroom, it is necessary also to link ‘transformation’ to the other didactical questions such as: why? what? for who? and when? In our view transformation involves dimensions of significance, in relation to what content in the curriculum is important and what content ought to be taught. Accordingly, to be able to make those choices, decisions must be made about the question why. This raises questions about the overarching purpose of schooling and of the subject or topic taught.

Within the traditions of didactics such processes are variously defined as ‘didactic transposition’ (Chevallard, 2002, 2007), ‘omstilling’ (Ongstad, 2006) and ‘reconstruction’ (Duit et al., 2012). From the perspective of curriculum studies, these processes are reflected in the work of Bernstein (1971) in relation to the concept of ‘re-contextualization’. Our definition of transformation is purposely broad and inclusive to make it possible to relate to these various concepts representing different frameworks. With reference to the Anthropological Theory of Didactics (ATD) (Chevallard, 2002, 2007) these processes of transformation are seen to occur both outside and within the educational system at the societal, institutional and classroom levels. These levels are related to the policy level, the programmatic level and the classroom level within the curriculum tradition as highlighted by Westbury (2000, p. 33). In turn, the associated transformation processes can be seen as being related to the intended, enacted and experienced curriculum.² This framework based on levels is used as the foundation for the model summarizing our theoretical framework as illustrated in Figure 1.

2.3. Epistemic quality, epistemic games and learning games

As indicated earlier, our initial theoretical framework was subsequently expanded by drawing on the tradition of subject didactics to include a focus on the concept of epistemic quality (Hudson, 2018). This is defined as the quality of the subject knowledge in question based on an analysis of the relations within the didactic triad. It is a significant aspect of the didactical interaction in relation to what teachers teach and what students come to know, make sense of and can do regarding the content knowledge of the school subject in question. This didactical interaction includes the joint action between the students and teachers within the pedagogical relation, the teacher’s role in guiding the student’s relation with the content knowledge through the didactical relation and the student’s learning. As indicated in the introduction, we see epistemic quality as a way of articulating aspects of what we mean by powerful knowledge at the classroom level.

Our framework also draws on key concepts from Joint Action Theory in Didactics (JATD) (Santini et al., 2018; Sensevy et al., 2005, 2008; Sensevy, 2011) for the analysis of the didactical interaction between teachers and students. In Gericke et al. (2022b) we draw on the ideas of epistemic games and learning games as ‘language games’ (Wittgenstein, 1997) specific to didactic systems. The concept of game is used to describe what happens in each didactic situation and allows us to describe the joint dimension of the didactic activity by modelling the interactions between the student and the teacher as participants in the same game. Particular attention is given to two games through the ways in which students participate in learning games in connection with epistemic games. Regarding the latter, an epistemic game refers to the game of the subject expert in his or her professional activity and two aspects distinguished. The source epistemic game refers to the human
practices that exist outside the didactic situation and the actual epistemic game is based on the analysis of class practices as they occur in practice. Secondly, the learning game is the reciprocal game of the student in relation to the joint game. In our framework, we use the concepts of epistemic game and learning game to connect epistemic quality to the concepts of transformation and powerful knowledge.

2.4. Trajectories of powerful knowledge and epistemic quality

In the process of comparing across school subjects, we consider the transformation processes between the societal and classroom levels. We note how the relation between school subjects and academic disciplines is emphasized within the framework of powerful knowledge. The concept of epistemic quality is considered further in Hudson (2022a) by relating to that of epistemic ascent (Winch, 2013) in the development of subject expertise. This is based on a continuum that reflects a trajectory in developing expertise from that of a novice towards that of an expert in the subject. Three distinct yet related kinds of knowledge are identified

![Figure 1. Our theoretical framework in the form of a mind map.](image-url)
by Winch (ibid) which are knowledge by acquaintance, propositional knowledge or knowledge that and procedural knowledge or knowledge how. The primary mode of knowledge by acquaintance is through the senses so that one may be acquainted with objects, events, processes, states and persons. In relation to powerful knowledge, there is a correspondence between knowledge by acquaintance and Young’s (2013) use of the term ‘everyday knowledge’. Regarding knowledge that, Winch (ibid.) argues that this cannot consist solely in the identification of true but isolated propositions, but that this is embedded within a conceptual structure, which is itself embedded within further related propositions. Third, in relation to knowledge how, knowing how to do something is seen an epistemic capacity that is related to knowledge by acquaintance and knowledge that given that knowing how to do something usually requires elements of the other two kinds of knowledge. In thinking about the nature of expertise, it is argued that this applies to both knowledge how and knowledge that and their inferential relationships (Brandom, 2000) with each other. In turn, subject expertise also involves knowledge of how to make and understand inferences to a very significant extent. Accordingly, the epistemic quality of the teaching enables a shift on the trajectory of development from the consideration of knowledge of low epistemic quality to that of high epistemic quality of the subject knowledge in question. The former can be characterized by a position in which knowledge by acquaintance and isolated beliefs based on authoritative testimony are predominant towards the more complex and interconnected higher-order knowledge that and knowledge how of an expert in the subject.

Through the application of our framework, we can model the findings of relevant studies as trajectories of powerful knowledge and epistemic quality whereby pedagogical practices are modelled as learning games, and epistemic practices are characterized as enacted epistemic games emerging through the unfolding of learning games in the classroom (Santini et al., 2018). Accordingly, we see the learning of powerful knowledge as a learning game in which the enacted epistemic game creates a learning situation that is successful. By this, we mean a game that connects the students’ everyday knowledge, knowledge by acquaintance, with the disciplinary knowledge, subject-specific knowledge and know how, in a way that facilitates students’ learning and the acquisition of that knowledge, for potential use in their future life worlds (Gericke et al., 2022b). This resonates with 2019) third sense of power in powerful knowledge, i.e. power as a generative aspect or a capacity-builder. In teaching of high epistemic quality, the disciplinary knowledge meets the knowledge by acquaintance, creating meaning by the student that interconnects the different knowledge types of the disciplinary powerful knowledge with the student’s previous experiences and knowledge of their own life world. Higher-order knowledge thereby evolves for the learner and creates meaning for their future experiences of the world, leading to a capacity to act in the future, i.e. knowledge of the powerful (Gericke et al., 2022b). Such learning games of high epistemic quality demand a connecting interaction between the teacher, the student and the powerful knowledge of the discipline and life world knowledge, all being important constituents or elements in developing knowledge of the powerful (ibid.).

A summary of our theoretical framework is presented in the form of a mind map in Figure 1. This aims to present an overview of the trajectories of development in terms of powerful knowledge and epistemic quality in the epistemic ascent from the classroom level involving the actual epistemic games to the high epistemic quality of the powerful knowledge at the policy/societal level involving the source epistemic games. We use this framework to consider the implications for curriculum planning in the final discussion following the comparison between school subjects and academic disciplines. Similarly, we use it in considering the implications for teacher education policy and practice with reference to outcomes of the comparison between subjects and disciplines. In doing so, we draw on the concept of teachers’ powerful professional knowledge (Furlong & Whitty, 2017) which builds on
the work of Young and Muller (2014) who reassert the importance of disciplinary knowledge in professional contexts. This focus on powerful professional knowledge and its implications for teacher education policy and practice has formed the basis for one of the three key research questions addressed by studies as part of the KOSS network. Through this question, several of the studies have considered how powerful professional knowledge can be characterized.

3. Analysing the Findings from recent empirical studies across school subjects

In analysing the findings across school subjects, we draw on the findings of several empirical studies documented in the anthologies including studies of various school subjects using the concepts of powerful knowledge, epistemic quality and transformation processes by Hudson et al. (2022a, 2022b). At the outset, we group the outcomes of the empirical studies into the four broad categories: (i) Mathematics, (ii) Social Sciences, (iii) Language (L1), Language and Literature and (iv) Physical and Life Sciences.

3.1. Mathematics

From the studies in the anthologies analysed here, four relate to mathematics. In addressing the nature of powerful knowledge in mathematics, Hudson (2022a) considers it as a long-term aim that is analytically discerned through the application of the concept of the epistemic quality. He argues that:

this resulted from the high quality of the teacher–student(s) joint action and the high epistemic quality of the content, which in turn can be seen to have produced an evolution in mathematical thinking and epistemic access/…/to powerful knowledge for all

(Hudson, 2022a, p. 32). Likewise, Golding (2022, p. 149) concludes that ‘importantly, we searched for evidence of access to epistemological ascent, without which learners cannot fully participate in, or appreciate, the powerful culture of the discipline’. Hudson (2022a) describes mathematics education of low epistemic quality that is characterized by an approach that over-emphasizes knowing that involving rule following, superficial memorized reasoning and right or wrong answers. In contrast, the knowing how is seen to be a prominent characteristic of high epistemic quality, such as mathematical thinking, problem-solving, creative mathematical reasoning and visualization. This study draws on the actual epistemic games and learning games at the classroom level by analysing the joint action of students and teachers. In turn, it provides an example of the epistemic ascent to the source epistemic games at the societal level as trajectories of powerful knowledge of high epistemic quality. In her study Golding (2022) argues that epistemic quality may be viewed in action as the quality of teaching and places the ability to accomplish teaching of high epistemic quality in the skills of the teachers, and most of these skills are related to the epistemological aspects of the mathematical knowledge.

Regarding transformation processes, Hudson (2022a) clearly distinguishes that epistemic quality can be seen first after the transformation processes have taken place. Golding (2022) focuses her discussion on the transformation between the academic discipline and the school subject. One of Golding’s major conclusions in her chapter is that teacher education should ensure teachers’ ‘transformation of those qualities for effective classroom use, so that they “know the mathematics” in epistemically and pedagogically powerful ways appropriate to their learners and contexts’ (Golding, 2022, p. 153). She continues by suggesting that transformation can be viewed as a skill of an excellent teacher. An important improvement in education is therefore to teach becoming teachers about these transformation processes as well as content and skills that mirror high epistemic quality.
Our focus shifts onto teachers’ powerful professional knowledge and the implications for teacher education policy and practice in considering the two chapters in the second volume. Hudson (2022b) places the PCK approach from the curriculum tradition in a didactic context by underscoring the similarities between the didactic tradition and the perspective of the teacher as a curriculum maker. The relationship between the didactic tradition and the PCK approach is emphasized in the final discussion by arguing that the concept of pedagogical content knowledge: ‘can be seen as the professional knowledge required by teachers in guiding the didactic relation’ (Hudson, 2022b, p. 149). In her contribution, Crisan (2022) explicitly focuses on secondary teachers’ content knowledge in mathematics education. Taking the PCK approach as her point of reference, she shows how necessary it is that mathematics teachers possess knowledge in mathematics that differs from other professional groups for which mathematical knowledge also forms part of the knowledge base. The term used for this content knowledge that is special to teachers is Specialized Content Knowledge (SCK) and this is attributed to the work of Ball et al. (2008). Crisan is convincing in her argument that teachers ought to have in-depth disciplinary content knowledge since that kind of high-quality knowledge can lead to an essential reflective relation to the specialized knowledge of the school subject. She connects content knowledge and the assignment of being a mathematics teacher, stressing that it is not enough for teachers to have a general understanding of mathematics. The teachers’ content knowledge must include aspects of content knowledge, enabling them to design situations in which students can learn.

The theoretical framework modelled in Figure 1 has enabled the analysis of the transformation processes as trajectories of powerful knowledge and epistemic quality from the source epistemic games in the intended curriculum at the societal level to the experienced curriculum at the classroom level. In considering trajectories of powerful knowledge and epistemic quality in school mathematics, high epistemic quality can be characterized as a balance between knowledge that and knowledge how and the inferential relationships between them. Also, we note that the concept of specialized content knowledge (SCK) highlighted by Crisan (2022) has grown out of the PCK approach in the curriculum tradition. Of particular interest, where the relationship between curriculum and didactics is an underlying theme, is that SCK provides an opening for the ‘didacticization’ of PCK and the idea of Subject-Specific Educational Content Knowledge (SSECK) at the programmatic/institutional level, which we return to in the concluding section of this discussion.

### 3.2. Social sciences

Regarding social sciences, six studies in the anthologies are analysed here. From the standpoint of subject didactics, the student-teacher-content interaction captures crucial dimensions in the processes of teaching-study-learning. The mind map presented here should be characterized as subject didactical since it centres around the didactical interaction. The concept of epistemic quality is included in the mind map and fits well with a didactical perspective. In turn, Nilsberth et al. (2022) show how epistemic quality might be used to characterize educational practices. It becomes obvious that the concept points towards the extent to which specialized knowledge becomes part of the didactical interaction. For them, the concept of epistemic quality is more complex as it also captures the staging of the content. The concept then describes a didactic joint what-how dimension, referring to the quality of the didactic interaction in the classroom.

It is relevant to pay attention to the connections between the different levels in the mind map. What happens in the classroom must be understood in relation to collegial processes, teacher education and the broader societal context. It concerns the question of the content to be raised in the didactic interaction. The intermediate level, the programmatic/institutional level, has an essential function in the framework. This is the level where teachers’ planning processes take place, whether it
is individual or collegial. In Stolare et al. (2022) and Randahl and Kristiansson (2022), it becomes clear how the programmatic/institutional level frames the professional didactic conversations between teachers. In the didactic tradition, the idea of the teacher’s didactic choices is fundamental. There is a notion of the ‘free space’ of the teacher. The teacher is understood as interpreting the curriculum and the syllabuses (Lehrplan) rather than just implementing them. This view is visible in that it is the teachers’ experiences and ideas about the didactic interaction at the classroom level, rather than the guidelines given in the curriculum and syllabuses, that characterize the professional conversations (Puustinen, 2022; Randahl & Kristiansson, 2022; Stolare, Bladh, et al., 2022). This is well in line with the argument by Mitchell and Standish (2022) that aspiring geography teachers need to be given the opportunity to develop into curriculum-makers and resonates with the concept of epistemic literacy introduced by Stones and Fraser-Pearce (2022).

In considering the concept of powerful knowledge, the boundaries between school subjects and disciplinary, specialized knowledge on the one hand and that between the school and everyday knowledge on the other are fundamental. These are demarcations however that need to be problematized. Nilsberth et al. demonstrate what happens when a lesson on law and order becomes scripted and closed, making it difficult for the students to relate to the content, ending up with a didactical interaction that could be characterized as of low epistemic quality. The balance between the content and the life world of students is a central dimension of the didactic tradition and is expressed in the mind map. Stolare, Bladh, et al. (2022) and Randahl and Kristiansson (2022) emphasize that when addressing an issue such as migration, teachers tend to remind each other about the students’ relations to the topic, their experience and previous knowledge.

The interplay between the specialized knowledge and the life world of students links to the idea of joint action, where the content is created in the interaction of the didactical situation. The nature of the content may be of importance; for some subjects, it is easier and more natural to establish such connections. It may even be that it is vital to connect disciplinary specialized knowledge and the world of life in areas where students have life-world-anchored knowledge, as in relation to areas such as migration and law and order might.

### 3.3. Language 1 (L1), language and literature

In relation to language (L1), language and literature, five studies in the anthologies are analysed here. In addressing the nature of powerful knowledge in language and literature, the perspective that humanities are characterized by different perspectives than for example science or contending frameworks that change over time have consequences for how both powerful knowledge and epistemic quality can be described. McLean Davies et al. (2022) argue that L1 teachers often reject or express discomfort with the concept of ‘literary knowledge’ as a way of articulating the important core of their subject on a societal level (see Figure 1). The teachers think that the subject’s role is to promote an understanding that is beyond the text itself and towards personal growth. In this way, powerful knowledge in L1 is about the connections between ‘knowing how’ and ‘knowing that’ in this curriculum area, which Grünthal et al. (2022) relate to also. They highlight that phases of literary understanding could be compared to the three dimensions of knowledge: the first and basic level is that of immediate personal response (knowledge by acquaintance), the second can be defined as propositional because it can be attained by answering questions (propositional knowledge), and the highest level is the procedural one, where the reader makes connections and contextualizes the reading experience meaningfully (procedural knowledge). Grünthal et al. (2022) argue that low epistemic quality means only propositional knowledge about literature. By asking only What-type questions about the texts, teachers’ questions do not strengthen the epistemic quality of the literary teaching. Also, Mclean Davies et al. (2022) advocate this, stressing that the kinds of propositional and pragmatic knowledge that enables
higher-order thinking and knowing could be regarded as being a part of the epistemic game and be regarded as high epistemic quality. This includes conceptualizing literary knowledge as centrally concerned with ways of understanding and connecting the field, as in dialogue with other knowledges. In relation to linguistic issues of L1, Egeland and Kulbrandstad (2022) find that linguistic diversity in the language classroom can be said to be integrated poorly into the subjects Norwegian and Swedish as second languages. Since students must be able to go beyond their prior knowledge in relation to knowing what and raise their language awareness by using all the languages spoken in the classroom in powerful ways, this has consequences for the epistemic quality of the studied subjects. According to Egeland and Kulbrandstad (2022), to be of high epistemic quality, language teaching for minority languages must consider language diversity. Also, Wegner et al. (2022) discuss high epistemic quality in language teaching and highlight that it should imply ‘knowing how’ as well as a critical joint reflection and negotiation of language and language use potential in relation to linguistic diversity in the classroom. Moreover, from the institutional level, and from the perspective of knowing what, Iversen Kulbrandstad and Kulbrandstad (2022) advocate that to develop powerful professional knowledge, L1 and L2 teacher education must offer a knowledge base built on different theories, making the students reflect on practice with the help of theories, as well as focusing on the importance of the choice of content.

3.4. **Physical and life sciences**

From the studies in the anthologies analysed here, two chapters relate to science. In the chapter by Hardman et al. (2022) a material-dialogic perspective is taken on powerful knowledge in chemistry teaching of chromatography. The chapter describes a classroom study of how learning takes place and how the learning is entangled with the material artefacts of the chromatography equipment (and other teaching artefacts) that is used to separate chemicals of different colours. In the second chapter on powerful knowledge and epistemic quality in education for sustainable development science teachers, teaching contributions to ESD of social science teachers and language teachers are compared (Sund & Gericke, 2022). This study comprises focus group interviews with teachers of science, social science and language who discuss and explain their contribution to the cross-curricula theme of ESD.

In the study by Hardman et al. (2022) the focus is on the classroom level only, i.e. the inner circle of Figure 1. The text explores the influence of material artefacts on the manifestation of knowledge in the classroom. The authors claim that a material-dialogic perspective frames disciplinary knowledge as bound within the phenomena of classrooms (Hardman et al., 2022). Hence, from our framework we would describe that the epistemic game enacted in the classroom is partly limited by the artefacts present in the classroom of that study. Using our framework, we could say that epistemic quality potentially enacted in a laboratory setting is partly dependent on the laboratory equipment available. That is, this study shows that the epistemic game is not only dependent on the knowledge the teacher brings to the table, but also on what artefacts are available to play out the epistemic game in the classroom. The inquiry taking place in the study, which is a scientific practice, resembles an authentic source epistemic game. However, the transformation process in which the chapter is described as emergent, i.e. dependent on the situation, rather than as intended and planned by the teacher. Hence, our model does not disclose whether a transformation process is emergent or intended, which would be a possible development of the model. An important argument in this chapter is that ‘the concept is not present in the room as some universal ontologically distinct ideal but present in the models that have presence in the classroom’ (Hardman et al., 2022, p. 169), in this case the chromatograms produced during the inquiry. Therefore, powerful knowledge is not directly experienced after transformations, but appears in the models that emerge in the inquiry. Based on this aspect it is of importance to recognize not only the transformation of ideas but also the transformation of source epistemic games into actual epistemic games. Probably, this aspect has less relevance in school subjects less rooted in specific academic disciplines.
The study by Sund and Gericke (2022) found that science teachers in comparison with social science teachers and language teachers focus more on the teaching of conceptual knowledge. This is based on the underlying idea that this knowledge would lead to students becoming more insightful and making favourable individual decisions in environmentally related issues. Hence, according to our model the science teachers try to stay close to the knowledge structures of their academic disciplines in their transformation of intended curriculum to enacted curriculum, see Figure 1. In contrast, the idea of powerful knowledge in the other teacher groups included more value laden issues besides their academic perspectives. For knowledge to be powerful for the learner it needed to involve the identification of desirable values for making collective decisions. By drawing on our model, Figure 1, we can see that science teachers understand powerful knowledge differently than the other teacher groups, and the transformation process takes various aspects into consideration. Based on these analyses, we see the usefulness of the model to explain teaching and learning of science in different contexts.

4. Analysing the boundaries between academic disciplines and school subjects

In analysing the boundaries between disciplines at the university level and school subjects, we draw on the Biglan classification scheme (Biglan, 1973) of academic disciplines in higher education. The scheme was developed in the USA and according to Simpson (2017) is probably the most cited organizational system of academic disciplines in higher education that ‘has current validity in a very different higher education system’ (ibid, p. 1520) with reference to the UK in 2013–14. It was developed through a study involving interviews with over 200 scholars in over 30 academic disciplines at two higher education institutions who were asked to group disciplines together according to their perceived similarity. The analysis used a multi-dimensional scaling technique based on their judgements and resulted in the identification of ‘dimensions’ across which the disciplines differed. Three dimensions were common to all the disciplines and related to (i) the existence of paradigms (Kuhn, 1962) that specify the appropriate problems for study and the appropriate methods to be used which were categorized on a hard-soft continuum, (ii) concerns with application to practical problems on a pure-applied continuum and (iii) concern with life systems on a life-nonlife continuum.

Figure 2 is reproduced from Biglan (1973) with permission and represents a plot of Dimension I (hard-soft continuum) horizontally against Dimension II (pure-applied continuum) vertically. It is highlighted that on the first dimension physical science and engineering areas are at the extreme negative end of the axis or the hard end of the hard-soft dimension while humanities and education are at the extreme positive end or the soft end of the hard-soft dimension. Biological areas identified as being on the hard side, though closer to the origin than are the humanities on the soft side. As Biglan notes, we have hard or physical science-oriented areas at one end of the dimension, social sciences towards the middle and humanities at the other end of the dimension. It can also be noted that mathematics is the closest discipline to the middle on the hard end of the dimension, which can be read as reflecting a greater degree of balance between the two extremes of the hard-soft dimension when compared to other disciplines.

The second dimension that is presented vertically is the pure-applied dimension. At the extreme positive end or applied end are education areas, which include curriculum studies and subject didactics. Biglan (1973) notes that accountancy, finance and engineering areas are also at the applied end of this dimension. Furthermore, he highlights that physical sciences, mathematics, social sciences, languages, history, and philosophy are at the negative or pure end of this dimension. In terms of the degree of balance between the two extremes the physical sciences, mathematics and social sciences are closer to the middle than languages, history, and philosophy on the pure-applied dimension.
These measures are based on multi-dimensional scaling, which is a means of visualizing the level of similarity of individual cases in a data set. So, it is necessary to recognize that the scheme of classification is based on a continuum involving a balance between the two poles of each dimension. It would be misleading therefore to conclude that mathematics, for example, is only concerned with 'appropriate problems for study and the appropriate methods to be used' (Biglan, 1973, p. 195) reflecting the description of hard end of the spectrum of dimension 1. It is also important to recognize that the four quadrants are not absolute categories. As Simpson (2017, 1521) rightly points out, the analysis has been almost universally mis-used as ‘a system of dichotomies in which the planes splitting the octants of the resulting three-dimensional pattern of disciplines neatly cleave them into hard vs. soft, pure vs. applied and life vs. nonlife categories’.

![Figure 2](image.png)

Figure 2. Dimension I appears horizontally, and Dimension II appears vertically.


In considering the boundary between the discipline of mathematics and the previous analysis of empirical studies of school mathematics in the KOSS anthologies, we draw on the first two dimensions of the Biglan classification scheme. In terms of the hard-soft dimension mathematics is positioned towards the hard end of the continuum and towards the pure end of the pure-applied continuum. As a result, the discipline of mathematics is positioned in the hard-pure quadrant in
relation to the first two dimensions. As highlighted earlier, however, it is important to note that these are not absolute categories and that mathematics is the closest discipline to the middle on the hard end of the dimension. Also, mathematics is closer to the middle on the pure-applied dimension than languages, history and philosophy. Accordingly, the nature of mathematics reflects a particular balance on both the hard-soft and the pure-applied continuum.

The hard end of the continuum involves a focus on ‘the existence of paradigms (Kuhn, 1962) that specify the appropriate problems for study and the appropriate methods to be used’ (Biglan, 1973, p. 195). In relation to this aspect, we see correspondence with propositional knowledge or knowing that at the school level with an emphasis on the development of ‘fluency in the fundamentals of mathematics, including through varied and frequent practice . . . and the ability to recall and apply knowledge accurately’ (Golding, 2022, p. 142). On the other hand, there is a correspondence between the soft end of this dimension and procedural knowledge or know how at the school level involving inferential knowledge (Brandon, 2000) and an emphasis on mathematical thinking, problem solving, creative mathematical reasoning and visualization. These latter processes are also associated with the applied end of the pure-applied dimension of mathematics. Indeed, in relation to the life-nonlife dimension many of these applications are also related to real life such as pandemics for example. In this respect, Brooks-Pollock et al. (2022, p. 139) highlight the way in which ‘mathematical modelling has been, and continues to be, a key tool contributing to efforts that seek the betterment of public health’.

Despite an intended mathematics curriculum document in England that constitutes an aspiration for expansive mathematics learning ‘well-aligned to the characteristics of high epistemic quality’ (Golding, 2022, p. 142) problems in the enactment of the curriculum remain. These are most apparent with learners in the primary and lower secondary phase where most teachers are not subject specialists. She notes that ‘even as a subject specialist in a performativity system, examination performance pressures mean that as an end, attainment is frequently privileged over subject grasp’. (Golding, 2022, p. 147). The impact of high-stakes external testing and inspection in also highlighted by Hudson (2022, p. 22) who points to the resulting transformation processes that involve a ‘heavy emphasis on memorization, drill and practice’ and which establish the ‘circumstances that can degrade epistemic quality into the mutated form of mathematical fundamentalism’ which leads to an experience for many learners of mathematics that is fearful and anxiety-inducing, boring, demotivating and alienating from the subject itself.

Regarding social sciences and humanities subjects in school, these have a solid societal connection and, therefore, often play a vital role in developing students’ civic competence. This means that these school subjects are closer to the applied end of Dimension 2 than is the case with the corresponding academic disciplines. It has been emphasized in the referenced empirical examples how important it is that the selection and transformation of powerful knowledge are connected to students’ experiences and life world. In fact, reflecting back on our analysis of the studies in the KOSS anthologies, it may be seen as a prerequisite for education to be characterized as of high epistemic quality. Finding a balance between what content is significant from a subject perspective and what is perceived as relevant by the students is key in these examples.

Moreover, from the empirical examples of the studies in relation to L1, challenges regarding distinguishing epistemic quality and powerful knowledge can be observed. These challenges are partly linked to the construction of the subject L1 that relies on two different academic disciplines, language and literature, respectively. The Biglan classification does not distinguish between these two aspects and instead refers to either ‘languages’ or ‘modern languages’, which are at the soft end of dimension 1 and the pure end of dimension 2. However, the language aspects of L1 can be considered as more towards the applied end of dimension 2, while the content relating to literature is more towards the pure end of this dimension as illustrated in the figure.

In relation to the science subjects of our empirical studies we can see in the comparative study by Sund and Gericke (2022) that science teachers, in comparison to social science teachers and language teachers, focus more on the teaching of conceptual knowledge. In this respect, we can see that secondary teachers seem to follow the Biglan (1973) classification scheme, and the transformed
knowledge form of science is more towards the ‘hard’ end of dimension 1 than their colleagues in language and social science education, at least in the context of sustainability education. Hence, the science teachers seem to try to stay close to the knowledge structures of their academic disciplines to a large extent when compared to other teacher groups. Likewise, when considering the study of laboratory teaching in chemistry education by Hardman et al. (2022) it was found that a scientific practice, laboratory work, that resembles an authentic source epistemic game was the learning goal of teaching. All the artefacts and instruments found in the secondary teaching environment imitate that of the academic practice, and the concepts in focus were chromatography and other related concepts of chemistry nested within that scientific practice. This also resembles the aim of secondary science education to mimic a pure discipline (at the pure end of the vertical axis in Figure 2). However, the picture gets more nuanced in a way when looking into teaching and learning in the learning game. The transformation process in the chemistry lesson is described as emergent, i.e. dependent on the situation, rather than as intended and planned by the teacher, which is intended to mimic the epistemic game of the discipline. Hence, a learning game cannot unfold or recontextualize a science practice, but as the study shows it will develop due to the situation. This is based on incorporating the interests or preconceptions of the students, and the emergent influence of artefacts in the classroom. In this way, the science education in secondary school is more applied and less hard compared with its corresponding academic discipline because of the influences of the learning game.

5. Discussion

In this final section of the paper, we consider the implications for curriculum planning and teacher education policy and practice. Regarding the former and considering the boundaries between academic disciplines and school subjects, three dimensions were common to the all the academic disciplines (Biglan, 1973). It is important to recognize that the four quadrants of Biglan’s classification are not absolute categories and that each discipline involves a specific and different balance on the continuum of each dimension. For example, and as highlighted earlier, mathematics as an academic discipline reflects a distinctive balance on the hard-soft continuum. On a proportional scale this might be seen as a concern for the hard pole compared with the soft pole of the first dimension in the ratio of two to one. At the school level, this balance is seen to be reflected in knowledge of high epistemic quality that is characterized by a balance between knowledge that and knowledge how and the inferential relationships between them. Furthermore, mathematics can be seen to be concerned with the pure and applied poles of the second dimension in a similar proportion.

In summary we see correspondence with the hard end of dimension 1 and propositional knowledge or knowing that. We also see a correspondence between the soft end of this dimension and procedural knowledge or know how at the school level also involving inferential knowledge. There is a need to avoid the false dichotomy between an over-emphasis on knowledge that of Future 1 and decontextualized generic skills of Future 2 in curriculum planning. Consequently, we need an overall balance between know that and creative know how that is specific to each school subject as part of Future 3 that sees knowledge as ‘involving sets of systematically related concepts and methods for their empirical exploration and the increasingly specialized and historically located communities of enquirers’ Young and Muller (2010, p. 14).

Finally, in relation to the implications for teacher education policy and practice, we return to the question posed by Furlong and Whitty (2017, p. 9): “How can disciplinary knowledge and other external knowledges be brought together with professionals’ reflective practice and practical theorizing in professional arenas to produce really powerful professional knowledge and learning?” They argue that they do not necessarily exclude other knowledges and emphasize there that is a critical pedagogical element to this aspect. They also highlight a key challenge for professional disciplines in terms of needing to establish precisely how disciplinary knowledge, that is epistemologically strong, articulates with other forms of knowledge and how it can thereby impact practice. In turn, they question how disciplinary knowledge and other external knowledges can be brought together with professionals’ reflective practice
and practical theorizing in professional arenas to produce powerful professional knowledge and learning. This discussion formed the basis for one of the key research questions addressed by the KOSS network.

With reference to their discussion of what powerful knowledge might be for Australian English teachers, McLean Davies et al. (2022) argue that it is essential that powerful knowledge is framed relative to educational practice. As we argue in Stolare, Hudson, et al. (2022) this suggests that teachers’ content knowledge should have a particular quality, something touched upon in more than one chapter and hence a recurring theme in the book. For example, Crisan (2022) explicitly focuses on secondary teachers’ content knowledge in mathematics education. She illustrates how necessary it is that mathematics teachers possess knowledge in mathematics that differs from other professional groups for which mathematical knowledge also forms part of the knowledge base. Based on the PCK approach, the term used for this content knowledge that is special to teachers is Specialized Content Knowledge (SCK) and attributed to the work of Ball et al. (2008). She argues convincingly that teachers need such in-depth disciplinary content knowledge that can lead to an essential reflective relation to the specialized subject knowledge of the school subject. She stresses that it is not enough for teachers to have a general understanding of mathematics. The teachers’ content knowledge must include aspects of content knowledge, enabling them to design situations in which students can learn.

This line of reasoning is resonant with that outlined by Stolare, Hudson, et al. (2022), in which the model of didaktikal reconstruction is used to analyse the dialogue of teachers discussing their teaching on migration in upper secondary schools. They argue (ibid.) that teachers need to possess deep disciplinary specialized knowledge, understanding the basic structure of the content, since that will allow them to address the basic themes and recognize the obstacles students may encounter in their learning process. As indicated earlier, the concept of Specialized Content Knowledge (SCK) has grown out of the PCK approach. Of particular interest here, where the relationship between curriculum and didactics is an underlying theme, Stolare, Hudson, et al. (2022) argue that SCK might provide an opening for the ‘didactization’ of PCK. It is emphasized that SCK is an idea of content knowledge defined in relation to the teachers’ educational and didactical mission. Using terminology from subject didactics this concept is described as Subject-Specific Educational Content Knowledge (SSECK) meaning that teachers’ content knowledge has a distinct integrated didactical character. As discussed in Stolare, Hudson, et al. (2022) SSECK might be expressed as an insight into the basic knowledge structure of the discipline and the school subject, and in reflected experiences of what it means to acquire the specific knowledge. Accordingly, one way of framing Powerful Professional Knowledge is to understand it as in-depth and reflected practice-relevant content knowledge.

In turn, Stolare et al. (2022) argue that the inherent nature of subject didactics in connecting theoretical perspectives and doing so relative to a teaching practice corresponds well with the reasoning of Furlong & Whitty (2017) while setting up the framework for powerful professional knowledge. Further, it is seen to correspond well with the way in which Barret and Hordern (2021) discuss the establishment of a foundation for teacher education that can be an expression of powerful professional knowledge. We see resonance here with the ideas of Barret and Hordern (2021) on ‘rethinking the foundations’ and with the discussion about General Subject Didactics by Vollmer (2021). Accordingly, there are strong arguments for making subject didactics a central field of knowledge within teacher education. It is argued further (ibid.) that the subject didactic perspective from which teaching, seen in the contextual knowledge —teacher–student interaction, also characterizes the teachers’ disciplinary studies and responds precisely to the desirability of developing teachers’ strong subject-specific educational content knowledge (SSECK).

Returning to the Biglan classification of disciplines in higher education, it can be seen in Figure 2 that education, and therefore subject didactics also, is in the far top right corner of the soft-applied quadrant of the figure. Accordingly, a graduate from the humanities and social sciences has a personal journey to make in becoming a teacher from a pure to an applied discipline at the soft end of dimension 1. However, a graduate in the physical & life sciences or in pure mathematics has an even longer distance to travel in terms of moving from a pure to an applied orientation and one of greater complexity in additionally moving from the hard to the soft end of Dimension 1. Our understanding SSECK as anchored in educational practice experiences suggests a link between
SSECK to what might be called ‘familiarity knowledge’ which has its roots in the philosophical tradition of Wittgenstein and Polanyi. Such knowledge enables teachers to evaluate and decide how to act in a specific situation and is built up through the systematic reflection on practice supported by mentors and tutors. In turn, this knowledge can be linked to the development of Bildung, “meaning that teachers’ knowledge base consists of an almost embodied specific understanding of the subject and its linked discipline(s), enabling them to transform the content knowledge and having the methods to do so” (Stolare, Hudson, et al., 2022, p. 238).

However, to enable teachers to develop the type of knowledge where practice and theory are interwoven, it is essential that higher education continues to play a vital role in teacher education. The trend towards decoupling teacher education from university teacher education institutions evident in countries like England, the United States and Australia is seen as a cause for concern. It is very unclear how such developments might contribute to developing a knowledge base founded on what may be characterized as powerful professional knowledge. In the light of this discussion, we have developed our theoretical framework further to include powerful professional knowledge and subject-specific educational content knowledge as illustrated in our revised mind map as shown in Figure 3.

![Figure 3. Revised theoretical framework in the form of a mind map.](image-url)
In conclusion, we argue that the insights gained from analysing the studies of various school subjects in Hudson et al. (2022a,b) could not have been gained without the development of a comparative research framework that has enabled us to consider a full range of school subjects and academic disciplines.

Notes

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References


