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Changing cultures of knowledge and learning in higher education

A literature review

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CONTENTS

INTRODUCTION

Ways of developing knowledge and learning of relevance for professional work, and the role of higher education in this, are in transformation in today's society. One aspect of this is that professional higher education programmes are subjected to change processes referred to as academic drift (Pratt and Burgess, 1974, Neave, 1979, Smeby, 2006) or academisation (Elzinga, 1990; Kyvik, 2009). This implies, for example, that professional communities have established throughout the last 20 to 30 years new or stronger links to science, as reflected in the emergence of research especially devoted to serve the professions, such as in nursing science and applied engineering, and in an overall orientation towards making professional work more knowledge-based. Another consequence concerns the introduction and rapid growth of profession-oriented master programs as well as professional doctorates in many countries. Second, the knowledge worlds in which educational programs are embedded are getting more extensive and complex. The knowledge domains of professionals, as well as the production of services and collective identities, stretch beyond the nation state and into an extended globalised space (Brint, 2001). More abstract and symbolic modes of representation give rise to "global forms" of knowledge, that is, forms that have a "capacity for decontextualization and recontextualization, abstractability and movement, across diverse social and cultural situations and spheres of life" (Collier and Ong, 2005, p. 11). Such forms of knowledge circulate quickly in information networks, and on its way it provides arenas for engagement as well as resources for the formation of new types of communities. As argued by Krishnan (2006), global circuits of knowledge fuel other forms of globalization, e.g. economical, political and cultural forms, by influencing the intellectual spheres of life. A third and related aspect is that the relationship between higher education and professional learning is in transition. The role of higher education is no longer restricted to the initial phase of preparing practitioners sufficiently for the world of work. Rather, practitioners enroll in higher education in different phases of their life to update or advance their competencies, and many higher education organizations engage more actively in efforts to develop professional practice by way of research and other knowledge-producing efforts.

These developments bring an extended research orientation to professional education and work, and hence also new and more dynamic relations between knowledge development and learning in the professions. The emergence of transnational knowledge cultures, as well as more complex tools and more epistemic modes of practice, transform ideas of professional expertise and its educational underpinning. The knowledge guiding professional work is not stable and given once and for all, but rather complex and multi-faceted, increasingly contested, and in constant development. In the wake

of this, expectations to practitioners are changing. While Abbott (1988, p. 8) once described professional work as a matter of "applying somewhat abstract knowledge to particular cases", professionals today are more often faced with tasks that imply active engagement with knowledge beyond contexts of application. Included are also responsibilities for selecting, validating and safeguarding knowledge in the context of work, for keeping issues open to investigation, and for engaging oneself in exploring opportunities for improvement. This undertaking involves intellectual and analytical engagement characteristic for knowledge-intensive work (Alvesson, 2004) which need to be prepared for in higher education.

To understand conditions for and processes of professional learning in today's higher education we will thus argue that we need to address education and learning in relation to wider ecologies of knowledge. Two aspects are of prime concern: First, the enrolment of practitioners in a profession-specific field of knowledge becomes a critical condition for engagement. Familiarity with collective knowledge as well as with the professions' specific modes of producing and warranting knowledge provides a ground for active participation. Second, active and critical engagement depends on awareness of circuits of knowledge that exceed the boundaries of local education and work. Increasingly, there is a need for practitioners to see ones role in relation to extended contexts for knowledge development and use. Learning can be seen as a matter of mastering the dominant discourses in a given field (Säljo, 1999), and in professional contexts these discourses are increasingly related to ways of handling knowledge and taking advantage of global circuits of knowledge in locally relevant ways. However, as knowledge environments are changing dramatically, we cannot take for granted that conventional insights in the conditions for professional learning are valid or sufficient. One question raised in this review paper is therefore: How has research on knowledge cultures and learning in higher education accounted for this development?

More specifically, this review will focus on the relationship of knowledge cultures to students' learning in higher education. However, the concept of knowledge culture is not a well-defined term. It is used in different ways within different research traditions, and its meanings and social manifestations may change over time. In the academic literature on higher education (e.g. Biglan, 1973a,b; Becher 1987, 1984), the concept of *disciplinary cultures* is often referred to when highlighting differences between academic programs and environments. In recent decades, however, the concepts of *epistemic cultures* and *epistemic communities* have come to the fore, first and foremost within the social studies of science and science politics, but more recently also as a way to describe cultural characteristics in today's society more generally (e.g. Knorr Cetina, 2007). This development reflects new relationships between science and society, which are likely to alter

constitutive mechanisms of community formation also in higher education. Our knowledge of how and to what extent new knowledge cultures are emerging and how they influence knowledge production and learning is, however, very limited, , and even more so when it comes to the professional domains. To contribute to filling this gap and better inform future research, this review epitomizes cultures of knowledge and learning in higher education, with a special interest in how the different conceptualizations highlight different aspects of knowledge and learning, and how their respective strands of research account for wider knowledge dynamics in a globalised world.

For revealing how this theme is addressed in research it is not sufficient to examine what we know about knowledge cultures and professional learning from previous research – that is, what are the main findings generated from research. It is equally important to ask: What kinds of questions are raised in relevant research? And: How are the cultural and epistemic dimensions defined and accounted for in the analytical perspectives utilised? Findings from educational research are generally contested and can not be read as stand-alone statements, as this research field comprise a range of different strands of theoretical and methodological approaches which highlight different aspects of the social world and produce knowledge in different ways. Moreover, from an empirical perspective, knowledge cultures and professional learning are both complex and multi-faceted phenomena which stretch out in time and space. Hence, through their choice of research designs, researchers actively create the space and time frames within which the phenomenon is studied, and choose the aspects to be highlighted. In our account of research contributions we will thus emphasise what questions are raised, how the phenomena are conceptualised, and which analytical approaches are used.

While research on knowledge cultures, their transformations and implications in today's higher education is a highly interdisciplinary and unsystematized field, research on learning in higher and professional education is marked with distinct traditions that to some extent have been summarized and systematized in former review studies. For these reasons we will highlight the first issue and discuss how recent research on knowledge cultures, their constitutive mechanisms and core functions pose new questions and allows for new ways of conceptualising and researching professional learning. However, to position this discussion in relation to previous research, we will also provide an overview of research on learning in higher and professional education.

The review is organized in two parts and structured as follows: In the first part, we provide a short overview of approaches used in research on students learning in higher education. This is followed by an account of core models and perspectives that have guided research on professional learning.

4

For these sections we draw on previous research reviews within the respective areas, especially those provided by Haggis (2009 a,b), Lahn and Jensen (2006) and Lahn (2010). The initial overviews serve to identify gaps in knowledge and provide the ground for what we consider as the main part of this review, namely the part dealing with research on knowledge cultures in higher education and professional contexts. This part aims to reveal how such cultures well as their operating forces are in transition in ways that transform conditions for learning in higher education. As the second part is based on our identification and systematization of relevant research, we have provided a description of the review approach utilised for this part as Appendix. We conclude the paper by summarising the main issues identified and by pointing to future needs.

PART 1:
RESEARCH ON LEARNING IN HIGHER AND PROFESSIONAL EDUCATION

Research on student learning in higher education

The number of studies addressing student learning in higher education is extensive. For the purpose of this report, we have limited our efforts to identifying main trends in relation to the interest stated above: How are the epistemic dimensions of learning in higher education accounted for in terms of conceptual and methodological approaches?

An interesting overview in this respect is provided by Haggis (2009 a,b). This study is a review of articles published in three main journals for higher education research in the period 1970-2007. The selected journals are *Higher Education (HE), Studies in Higher Education (SiHE),* and *Teaching in Higher Education (THE).* Although the journals are UK based, they publish articles from a range of countries across the world and were chosen because they are considered among the most prestigious and influential journals in the field. Haggis draws on Tight (2007) to argue that HE is considered as the leading non-North American international higher education journal, while SiHE is the leading UK-based one. THE represents a more recently established journal that was included to provide variety in the scope and profile of publications. The analysis was performed as a content analysis, starting with the ways in which learning was conceptualised in the article titles for in the next step to identify what models and research approaches they draw upon. Haggis has also compared his analysis of publications in these journals with publications in two main North-

American Journals (2009a), and with research published in the related areas of adult education and sociolinguistics (2009b). Moreover, the results are compared with key theoretical moves in psychology and sociology in the same period of time (Haggis, 2009b).

Haggis' analysis shows that research on students learning in higher education has been dominated by phenomenographic approaches in the given period. This strand of learning research has been developed within higher education research, and grows out of the work of Ference Marton and his colleagues in the 1970s and 1980s (Marton and Säljö, 1976a and 1976b; Marton, Hounsell and Entwistle, 1984). In this tradition, learning is investigated from the students' perspective, with an interest in revealing the variety in how students understand learning content and the approaches they take as learners. Learning is in this research seen as a cognitive phenomenon which is examined through concepts like deep and surface approaches to learning. The individual student is usually taken as the unit of analysis, and their learning approaches are examined by way of questionnaires and interviews. In later years however researchers have started to see the approaches taken by students in relation to teaching approaches employed by teachers in higher education (e.g. Trigwell, Prosser and Waterhouse, 1999).

Other approaches than phenomenography are also represented in higher education research to some extent, like the more recent studies of students' epistemic beliefs and self-directed learning strategies (e.g. Schommer-Aikin, Duell and Barker, 2003; Muis and Sinatra, 2006; Bråten, Gil, Strømsø and Vidal-Abarca, 2009). Anyhow, the review conducted by Haggis shows that research on student learning in higher education primarily has rested on a cognitive perspective. Hence, it represents a narrower scope of questions and methodologies than what is the case in the neighbour disciplines of adult education and also in sociolinguistics. The turn towards socio-cultural and interactional perspectives that emerged in other fields during the 1980s and 1990s has not been taken up in higher education research to the same extent. Individualistic and psychological approaches still seem to dominate the picture, and, according to Haggis, research on student learning in higher education is thus not only narrow in the sense of being restricted to a psychological approach, but it is also narrow compared to available perspectives within psychology itself (2009b, p. 384). In addition, the developments that have taken place in sociology during the last decades, like the emergence of Actor Network Theory and Complexity Theory, are not reflected in research on students learning in higher education. Haggis concludes that core journals in the field of higher education research seem to be "at least one, and sometimes two, decades behind research in the two fields which have traditionally most directly informed the development of educational theory" (2009b, p. 385).

6

The above described review has its limitations in terms of relatively few targeted journals and a somewhat narrow scope for the content analysis. At the same time it covers four decades of publishing, and examines the main identified trends in relation to what has been going on in neighbour fields and disciplines. In this way it gives a sound picture of major trends, as well as of the costs and benefits of organising a research field around a limited set of conceptual and methodological approaches. As to the interest of this report, we note that research on student learning in higher education has primarily focused on students as individuals and to a lesser extent engaged in researching the cultures of higher education as constitutive contexts and sites for their learning. Not included in this research are examinations of the cultural practices, assumptions and histories on which higher education practices rest. Moreover, the epistemic and trans-local dimensions of learning in higher education are not well understood. This seems to be the case also for research in the North American context, which only to a minor extent focuses on knowledge as a theme (Tight, 2007). As Haggis (2009b, p. 389) states, "research into learning [in higher education] is still not able to deal with 'the fleeting', 'the distributed', 'the multiple' and 'the complex'", nor with the ways in which learning emerge as interactional processes over time and across learning situations.

However, some of these issues have been addressed in research on professional learning. In the next section we move into this area, concentrating on main conceptual models and approaches that has been utilised to examine professionals' learning in education and work. As our interest is to reveal how and to what extent cultural and epistemic dimensions of professional learning have been accounted for, we restrict the description to the socio-cultural models, and do not go into e.g. the more cognitive traditions of researching expertise development which has been employed in some professional domains (for overviews of these fields, see for instance Ericsson, Charness, Feltovich and Hoffman, 2006; and Bozhuisen, Bromme and Gruber, 2004).

Professional learning: conceptual models and research strands

In the wider context of learning research, the second part of the 20th century brought to the fore several distinct traditions that live in parallel but have achieved paradigmatic status in different phases. From a state where behaviorist and cognitive perspectives dominated the research field, socio-cultural and situated approaches were developed in the 1990s and turned researchers' attention towards the social and interactional aspects of learning. A constitutive text in this regard was published by Greeno, Collins and Resnick in the Handbook of Educational Psychology (1996).

For research on professional learning, this 'sociocultural turn' was supported by the influential role of the book *Situated learning: legitimate peripheral participation*, which was published by Jean Lave and Etienne Wenger in 1991 and later followed up in e.g. Lave (1993) and Wenger (1998). In this perspective, learning is seen as a process of socialization within expert communities and conceptualized as a movement from being a 'legitimate peripheral participant' to becoming a full member of a professional community. Core concepts launched to analyze these processes were communities of practice, trajectories of participation, and learning to become a competent participant by way of access to, imitation of and identification with practice as enacted by more experiences practitioners. This perspective highlights the social organization of activities and learning as an integrated part of work, as well as the learners' changing capabilities of participation as they move towards more central tasks in the given practice. It has been utilized for studying learning in a range of professional and vocational occupations (see, for instance, Chaiklin and Lave, 1993) and paved the way for researchers to reconceptualize and reclaim the value of apprenticeship models (e.g. Nielsen and Kvale, 1999). However, although this perspective highlights the constitution of communities and the role artifacts play in this respect, it is primarily oriented towards the social aspects and does not account sufficiently for the epistemic aspects of work and learning, or for transformations in knowledge over time (Lahn and Jensen, 2006). Another limitation is the emphasis placed on communities as single, localized and bounded fields of practice, which implies that practice is understood within these boundaries rather than as constituted as complex relations and movements across multiple sites (Jewson, 2007).

Another influential strand of research on professional learning has emerged from Cultural Historical Activity Theory (Engeström, 1987; Engeström, Miettinen and Punamäki, 1999). In this tradition, learning is conceptualized as expansive, embedded in object-oriented activity, and mediated by tools and objects in a given activity system. Development and change is here understood as driven by contradictions in and between activity systems. The concept of activity system includes material and symbolic resources and the way these are negotiated and transformed as people engage with the object of activity, as well as the activity's dependencies on institutional characteristics like division of work. Moreover, the idea of activities as object-mediated refers to a double meaning of the object, referring to its instrumental character as well as its mediating function (Miettinen, 1999; Lahn and Jensen, 2006). Research within this line of theory typically takes the activity system as its unit of analysis, with an increasing interest for how new practices emerge at the interface of two or more activity systems, and for how organizational change can be facilitated in researcher-practitioner collaborations around joint creation of artefacts and objects (e.g. Engeström, 2001). Human action is

seen as essentially mediated, and the role of artifacts and objects in facilitating change is a core issue. Recent developments in this theory also develop models to understand dialogue, multiple perspectives, and networks of interacting activity systems, hence taking into account several of the shortcomings pointed to in Haggis' review of students learning. However, activity-theoretical studies of professional learning in educational contexts are sparse, as most studies that address the professions are carried out in work settings. And, as argued by Lahn and Jensen (2006) and Lahn (2010) in their accounts of models for professional learning, the activity-theoretical perspective has not accounted sufficiently for the epistemic character of tools and objects. Although discussed by Miettinen and Virkkunen (2005) and Engeström and Blackler (2005) as emerging interests, even these more recent socio-cultural approaches to studying professional learning have tended to downplay the role of knowledge in the formation of expert communities.

To address these shortcomings, Lahn and Jensen (2006) have launched an alternative approach to the study of professional learning called 'the epistemic tool perspective'. They follow up on the ideas of object-mediated activities from the above described strand of research within cultural historical activity theory, but take as a point of departure that, in the context of professional practice, artifacts and tools are inevitably interlinked with knowledge. The objects and artifacts at disposal for professional practitioners incorporate central features of the knowledge field in which the practice is situated, and serve to mediate historical and recognized ways of doing professional work. At the same time they are not stable but in transition, and they are interpreted, used and brought forward in different ways relative to the explorative practice in which they are embedded. The use of epistemic tool both transforms the professional practice and is transformed by it, in ways that are linked not only with the dynamics of the organization or workplace but also with wider knowledge ecologies. To account for these dimensions of tool-mediated practice, Lahn and Jensen (2006) seek to combine insights from Knorr Cetina's (2001) idea of epistemic objects with the perspectives of knowledge as a structuring force from Basil Bernstein. In this way they position materialized knowledge as a constitutive agent in learning processes. This perspective also transcends the more stability-oriented notions of professional communities by paying attention to the creative and constructive dimension of professional work, allowing for examining how practitioners continually reinvent their own practices through engagement with epistemic tools and objects. The epistemic tool perspective has been developed further and described by Lahn (2010), who expands on the 'knowledge creation metaphor' of learning (Hakkarainen, Palonen, Paavola and Lehtinen, 2004; Paavola and Hakkarainen, 2005), to account for how professional learning plays out over time and is constituted in multifaceted and mediated network relations that is interlinked with dynamics of

knowledge development. To bring the knowledge relations of professional practice to the forefront, professional learning is conceptualized as 'epistemic trajectories'.

Studies that address the epistemic dimension of practice and learning have been carried out in different areas and contexts in recent years. In the UK context, Edwards (2007, 2010) has investigated how practitioners collaborate in inter-professional work where several expert domains are involved. She has launched the concept of 'relational agency' to highlight how different areas of expertise need to be aligned in such work. A main argument is that productive collaboration rests on the practitioners' relational capacities which in itself form a type of expertise. Guile (2009) shows concern for the historical development of professional practice, and argue that the perspective of epistemic objects fills a gap in the literature on the genesis of practice by highlighting how knowledge 'itself' is a driver of change and development by way of its self-multiplying capacities. Researchers have also employed the perspective of epistemic tools and objects in empirical analyses. Damsa *et al.* (2010) used the concept of shared epistemic agency to investigate how groups of university students collaboratively created shared knowledge objects in the context of instructional design activities, and showed how this type of agency was constituted and differently articulated in different groups. Jensen and Lahn (2005) showed how nursing students engage with the concept of care as a knowledge object which incorporate ideas generated through science but at the same time present itself as an open-ended object which allows for – and asks for – multiple interpretations and use. They describe how students first find the abstract, decontextualised world of theory challenging, but that the 'back-and-forward looping between theoretical input and practical experience' offered in the educational program seems to involve the students in objectual dynamics and create ties to knowledge over time. Similarly, analyses of computer engineers' ways of engaging with distributed knowledge resources take the form of objectual practice which is mediated by a rich provision of epistemic tools. These tools serve to stimulate further investigations as well as to link local practices with wider knowledge networks as they are brought into local problem solving (Nerland, 2008; Nerland and Jensen, 2010).

Related studies of epistemic tools and infrastructures in professional contexts have been carried out also from more socio-material perspectives within organization studies. The research group RUCOLA[1] at the University of Trento has played an important role in this regard, for instance as manifested in the studies by Bruni (2005) and Bruni, Gherardi and Parolin (2007), which investigated the role of electronic patient journals as agents and environments for knowing in professional

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[1] Research Unit on Communication, Organizational Learning and Aesthetics

practice, and by Gherardi and Nicolini (2000) who analyzed how safety knowledge circulate and emerge in organizational practices by way of collective achievements. Socio-material perspectives on professional practice have also been employed in other studies, e.g. by Østerlund (2008) in the context of health care, and by Ewenstein and Whyte (2009) who analyze the role of drawings and visual representations in design work, by conceptualizing these as epistemic objects and boundary objects relative to their function in the design practice. Studies in this line of research draw on perspectives from Actor Network Theory and are hence able to account for "'the fleeting', 'the distributed', 'the multiple' and 'the complex'" aspects of practice that Haggis (2009b) identified as important lacks in research on students learning in higher education. Seen together, these studies have contributed by showing how complex knowledge work rests on collective accomplishments and how such work is achieved in object-mediated practices. On the downside seen from the interests of this review, they are typically concerned with professional practice in work contexts rather than in higher education[2], and analytically they tend to focus on how practice is carried out in the local work context rather than tracing its connections to wider ecologies of knowledge. Although the presence of such ecologies and their global or transnational dimensions often is acknowledged as a backdrop for this research, it is not brought into the analytic focus as such.

To sum up on this part, we recognize that reviews of research on professional practice and learning show a more varied picture than the reviews on student learning in higher education, and that the former to a larger extent has developed ways of accounting for learning that are sensitive to shifts in knowledge and the dynamic and multifaceted dimensions of knowledge work. These approaches are however hardly ever brought into studies of learning in higher education contexts, and they are still somewhat restricted when it comes to ways of addressing wider networks and ecologies of knowledge. This is probably due to the fact that they often take epistemic objects and object-mediated practices as their focus of analysis, rather than the knowledge culture in which these objects and practices are embedded. Emerging question that are left unresolved are thus: *What roles do wider knowledge cultures play as constitutive arenas for community formation and learning? How are the character and social manifestations of such cultures possibly changing in today's higher education? And how can we account for their influence, conceptually and in empirical research?* To address these questions, we proceed to Part 2 and to the review of research on different types of knowledge cultures.

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[2] The study by Nespor (1994) forms an important exception to this picture. As this study also relates to research on academic disciplines and programs, it will be described in part 2.

PART 2:
CULTURES OF KNOWLEDGE AND LEARNING IN HIGHER EDUCATION

As described in the appendix, the analysis of literature for this part took place in several steps. First, the different studies were organized as to how they explicitly or implicitly conceptualized cultures of knowledge and/or learning. This resulted in three main categories of research on knowledge cultures, namely disciplinary cultures, epistemic cultures, and epistemic communities. Then they were grouped in relation to their type of research questions and design. As a third step, the studies within each of these categories were examined as to their units of analysis, core analytical concepts, and findings. In this step, we also considered similarities and differences between the studies in how processes of knowledge production and distribution are accounted for, and how this relates to the enrolment and engagement of practitioners. Based on these examinations, we selected a set of studies to be more explicitly discussed in this review, which together shows the variety as well as similarities and differences in and between the strands of research. In the text that follows, these studies are organized and presented under the headings of the different types of knowledge cultures.

Disciplinary cultures

One strand of research, which also comprises studies that are considered as classics in the higher education literature, deals with disciplinary cultures. Such cultures are investigated for the sake of revealing differentiated cultures within academic institutions, and found to be marked by historical accumulation, a high degree of specialization, and distinct institutional community features. Following Clark's (1989) account of the university, the discipline provides a primary culture for academic workers, while the academic profession at large forms a secondary culture. For the purposes of this review, we will delve into two projects on disciplinary cultures, namely the one by Biglan (1973a, b) and the influential work by Becher (Becher 1987, 1989; Becher and Trowler, 2001). These studies have in common that they considered faculty views and perspectives to characterize the various disciplines from a cultural point of view, and used these data to create classification schemes to reveal similarities and differences between the respective cultures.

To understand the commonalities and differences among 33 disciplines in higher education in USA, Biglan (1973a) studied the perceptions of faculty from one large public university and one small private liberal college. Using multidimensional scaling techniques, he classified academic disciplines

into four categories based on three dimensions. Dimension one was the level of paradigmatic consensus in the disciplines as described in hard versus soft terms. Physical sciences and mathematics have distinct paradigms (there is hard paradigmatic consensus) whereas there is soft/less paradigmatic consensus in the humanities and education. Dimension two was the practical application of disciplinary knowledge, expressed as pure versus applied. Accounting, finance, education, and engineering are classified as applied disciplines whereas history, mathematics, philosophy, and physical sciences are less concerned with application. The third dimension was the disciplines' involvement with living/organic objects of study (life vs. non-life systems). Education and biological sciences are considered as life disciplines whereas computer science, engineering, languages, and physical sciences as non-life disciplines. Overall, each discipline is classified three times based on the three dimensions. According to this work, disciplines embody different cultures related to their epistemological core, their research goal, and their epistemic objects.

Biglan (1973b) has also used this classification scheme to study the characteristics of departments and the output of their faculty. Findings indicated that faculty from hard disciplines were more socially connected, more interested and involved in research, and more likely to publish articles in academic journals than their colleagues in the soft disciplines. Applied professionals were more socially connected, more interested and involved in service activities, and more likely to publish technical reports than their colleagues from the pure disciplines. And life scholars were more socially connected, less interested and involved in teaching than nonlife faculty. These characterizations focus on social fabrics of faculty members, their research productivity, and dissemination modes and rates. As Biglan's study is conducted almost 40 years ago, and the contexts for research and teaching have changed in many respects, the study is primarily of interest in terms of its analytical framework and its way of providing a historical picture of academic work. However, Biglan's work is widely cited in the higher education literature, and studies that have used Biglan's classification scheme as a conceptual framework for analyzing disciplinary differences were identified across a range of settings. Among these is the work by Becher (1989; Becher and Trowler, 2001), who appropriated Biglan's classification and came up with a slightly revised version.

At the core of Becher's classification is the distinctive nature of 1) disciplinary cultures, and 2) knowledge. Culture in this context refers to "a shared way of thinking and a collective way of behaving" as well as to the set of values, beliefs, and symbols that govern the behavior of groups or society (Becher, 1984, p. 166). Accordingly, academic disciplines are seen to hold norms, values, traditions and belief systems which constitute certain logics of knowledge and knowledge

13

production. This anthropological perspective provides opportunities to investigate how cultures of knowledge evolve across time and space, as well as to differentiate between different cultures. Becher distinguishes between four disciplinary groupings, along the core distinctions between soft and hard sciences, and pure and applied modes of knowledge production. Disciplines that are classified as soft and pure, such as history and anthropology, are described as individualistic, pluralistic, loosely structured, task-oriented, and have low publication rate. Soft and applied disciplines, such as education, are described as more outward looking, uncertain in status, fashion and power-oriented. The nature of knowledge in the former is reiterative, holistic, and concerned with particulars and qualities with interpretive focus, whereas it is functional, utilitarian and results in protocols in the latter. In hard and pure disciplines such as physics, the nature of knowledge is cumulative, concerned with generalizations, quantification and results in discovery. Finally, hard and applied disciplines such as mechanical engineering are typically purposive; pragmatic; concerned with mastery of the environment, and their research efforts typically results in products. The disciplinary cultures in the hard and pure group are competitive, politically well organized, and task-oriented, whereas they are described as entrepreneurial, cosmopolitan, and role-oriented in the hard and applied group.

The research on disciplinary cultures has contributed to our understanding of how different knowledge domains generate distinct patterns of social organization. Moreover, it has developed a set of categories for analyzing and describing such differences, for instance by distinguishing between whether the logics of knowledge production are oriented towards generalization or specialization, whether the methodological approaches strive towards pluralization or unification, and whether the relations towards the outside world is marked by openness or closure. In later decades this perspective has also been utilized for the sake of identifying further differences between disciplines when it comes to their implications for teaching, learning, and curriculum development (Hativa and Marincovich, 1995; Knight and Trowler, 2000; Smeby, 2000; Neumann, 2001; Neumann, Parry and Becher, 2002; Mueller, 2009). This research has contributed with specifying the knowledge-related and socially related aspects of teaching and learning, for instance along the categories of curriculum, assessment, teaching methodologies, and expectations to students. It has pointed to the importance of recognizing the distinctive features of knowledge domains and their social environments if we are to understand key aspects of teaching and learning. However, when it comes to research approaches, the studies on disciplinary cultures largely rest on interviews and self-reported data from academics and students within the contexts of specific universities or educational programs. In this way, individuals' relations to and conceptions of their

knowledge domain becomes a prime unit of analysis, while the more dynamic socio-material 'machineries' of knowledge production as well as their complexities and outreach in time and space easily fall out of scope. The learning environment generated from disciplinary cultures is thus accounted for in terms of formal curricula and teaching practices, as well as expectations raised to the students within these practices. Students' enrolment and participation in wider knowledge cultures, and the tools and infrastructures that support such participation, is not addressed.

One influential study that overcomes these lacks is the study by Nespor (1994), which investigates how students are mobilized as learners in the two undergraduate programs of Physics and Management by way of an ethnographic approach. Drawing on Actor Network Theory in combination with other socio-cultural perspectives, Nespor (1994, p. 131) defines learning as segments of "knowledge in motion", which "follow the shapes of more stable institutional or disciplinary networks". The analytical focus is on the socio-temporal networks of relations that produce and reproduce the educational tools and practices, such as lectures, presentations sheets, notebooks, and social arrangements in auditoriums and classrooms. These elements are acting, acted on and acted with, and constitute trajectories that differ in their socio-spatial outreach and shape the ways students are mobilised and become enrolled in distinct ways. Although his focus is on two specific undergraduate programs, the analytical approach utilised in this study is sensitive for how the material tools and practices enacted in these programs are interlinked with wider networks. The programs are seen as regions in more complex networks, which simultaneously "concentrate student activity within bounded material organizations of space-time" and link students to "distant sites of disciplinary practice through representational organizations of space-time" (p. 133). An important distinctive feature of educational programs is thus how they arrange for different and often simultaneous modes of engagement. As Nespor states (p. 9), "Communities aren't just situated in space and time, they are ways of producing and organizing space and time and setting up patterns of movement across space and time".

Nespor's study forms a novel contribution to the study of disciplinary cultures of knowledge and learning in higher education. Despite the fact that it has been met with considerable interest, it is to our knowledge not followed up in similar studies in higher education contexts. Nespor himself has however conducted another study (Nespor, 2007), in which he examined the organization and representation of time in an undergraduate sociology program in a US university. For this study he interviewed 18 final-year sociology majors, and analyzed 32 transcripts of previously graduated sociologists. A "curriculum chart", that is, the written requirements for the major, is seen to define academic time in terms of structuring which kind of courses and activities should follow from the

completion of others, and in what order. When analyzing the students' movements in these charts, he finds that they use and reuse the 'units of time relations' offered in the educational program in a variety of ways, by which different educational trajectories are generated and students move in asymmetric patterns. For instance, the major in sociology more often formed a passage between or on the way to other educational enrolments, than serving as a basis for a career as sociologist. This study thus points to the need of researching enrolment and participation in educational programs as it emerges in complex space and time relations, rather than taking the institutional organization of the curriculum as given.

By focusing on motions and mobilisation in disciplinary networks, Nespor's research provides a way of accounting for the distributed, complex, multi-faceted and dynamic aspects of educational practices. At the same time, seen from the interests of this review, it shares a shortcoming with many ANT-based studies in that knowledge is not explicated as something distinct that develops and structures modes of engagement over time. Instead it is seen as a social agent that emerges in line with other subjects and objects in the given socio-material network. To account for the constitutive role of knowledge objects and knowledge practices over time, we now turn to another strand of research which evolves around the concept of epistemic cultures.

Epistemic cultures

A prime contributor to this strand of research is Knorr Cetina (1999) who argues that the notions of disciplines and scientific specialties historically has captured the differentiation of knowledge, but that these terms do not sufficiently capture the strategies and policies of knowing that inform expert practice. She thus uses the concept of epistemic cultures to "amplify the knowledge machineries of contemporary sciences until they display the smear of technical, social, symbolic dimensions of intricate expert systems" (Ibid, p. 3). Culture here refers to "the aggregate patterns and dynamics that are on display in expert practice and that vary in different settings of expertise" (Ibid, p. 8). It seeks to highlight the epistemic and symbolic dimensions of practice and, compared to disciplinary cultures, it focuses more explicitly on processes and practices related to knowledge production.

Knorr Cetina (1999) has developed this perspective by way of a comparative, ethnographic study of the cultures of high-energy physics (HEP) and molecular biology, which reveals how two research teams' strategies and arrangements for knowledge production take fundamentally different forms. The institutional context of high energy physics laboratory is described in terms of horizontal circuits between tasks directed towards technical objects. A characteristic feature is to create new

knowledge by way of "negative knowledge"; the ruling out and delimiting of knowledge. This presupposed a culture of 'management by content' based on principles of responsibility and shared criteria for decision making. The 'ordering frameworks' are shared theoretical knowledge, models, simulations and statistical procedures that guide the process of discovery and the establishment of the 'truth-like character of the results' (Knorr Cetina, 1999, p. 179). In contrast, molecular biology flourishes in more conventional laboratory conditions because experiments in this field are conducted in environments where researchers work in accordance with a set of protocols issued by the head of the laboratory. The primary aim is to generate experimental knowledge about known molecular structures. Molecular biologists achieve this by responding to a problem by trying different variations of their laboratory procedures in a context of competition, with the expectation that it will result in the discovery of new evidence. By comparing these cultures, Knorr Cetina reveals different ordering patterns and construction principles in cultures that 'create and warrant knowledge' which also incorporate different placements of the knower – resting on communitarian mechanisms in the first case, and individuation in the other. In sum, the study reveals how epistemic cultures are constituted by their distinct heuristic practices and knowledge relations - including instruments, configurations of people and things, strategies, ways of envisioning knowledge, and the ways in which these factors come together to constitute a certain knowledge world. There is a mutually constituting relationship between these arrangements and mechanisms, at the same time as they work together as 'machineries of knowledge construction' which 'make up how we know what we know' (Knorr Cetina, 1999).

The concept of epistemic cultures has inspired further research in a range of settings, and is developed further in different ways. While Knorr Cetina's focus was on epistemic cultures within established sciences and with an overall interest in the mechanisms of differentiation, Kastenhofer (2007) built on this work to investigate how epistemic cultures converge and form new interdisciplinary cultures of knowledge production. As a starting point she identifies a set of changes in scientific cultures which also reflect changes in relations between science and society:

- A general shift in all sciences towards biological issues and objects, and a relative blurring of boundaries between related fields (e.g. biology, medicine, and physics converge towards biomedicine and biophysics)
- An ongoing process of molecularization within the life sciences and a relative boundary blurring between the biological sub-disciplines (e.g. molecular biology and genetics partially fuse with genomics)
- A shift in laboratory life sciences toward technology

17

- The emergence of new technoscientific-industrial complexes

- The emergence of new fields of critical expertise which combine epistemic systems and societal consultancy (e.g. popular epidemiology, medical practitioners, environmental medicine)

From this contextualization of emerging trends and change drivers, she moves into the problem of interdisciplinary research and examines how epistemic cultures may come together – or not – in research efforts that have a trans-epistemic character. As analytical tools for this examination Kastenhofer (2007) describes how changes in the organization of science can take three different forms, conceptualized as convergence, divergence, and emergence respectively. She then focuses on convergence and identifies three modes of convergence in scientific fields, conceptualized as cooperation, integration and assimilation.

Cooperation refers to how groups of scientists cooperate temporarily to solve a particular problem. In biophysics, for instance, cell cultures or human tissues are brought from biological and clinical labs. This kind of cooperation is called ancillary science and does not involve joint participation in the epistemic process itself. Symmetric cooperation is for instance observed in the interdisciplinary field of safety research on electromagnetic fields of mobile phones, which involves medicine, biology and physics. *Integration* refers to a process where individual experts, research groups, or institutions integrate under already existing research groups or institutions, and start to follow a different research trajectory. This is one way of dealing with serious competition for resources, sometimes following from a successful completion of joint projects. Integration is however limited to fields that share or combine their heuristic systems, as in the fusion of biology and physics into biophysics, and biology and medicine into biomedicine. The term *Assimilation* is used when convergence is manifested in the cultural assimilation of those involved in a research project. It may also take form as transformation of existing or emergence of new trans-epistemic models, theories, epistemic objects, technologies, and funding potentials. Examples include the trend in the natural sciences towards investigating biological research objects, the related development of molecularization within biological sciences, and the increased use of technological applications in the life sciences.

By identifying and describing the features of these different degrees of scientific convergence, Kastenhofer provides insights in the increased complexity of knowledge production in today's society as well as the change dynamics in its social organization. The study points to how epistemic cultures simultaneously are consistent and in constant transformation, relative to the problems and projects that are worked upon. While constituting the 'building blocks' of interdisciplinary research

and science-society relations, the different cultures may themselves be transformed as a result of converging processes. Moreover, the study points to how epistemic cultures interplay with other organizational and political dimensions (like funding schemes) when research activities are organized. It also illustrates how the embeddedness of practitioners in epistemic cultures is dependent on how knowledge practices are organized in time and space, as well as the character of network relations that define them.

Kastenhofer's analysis focused on the epistemic cultures as such, and followed transformations in their constitutive elements in terms of convergence rather than the participants' work and their enactment of knowledge practices. One study that goes further into this aspect in the context of a scientific project is the one by Böschen (2009). Taking the perspective of epistemic cultures as a starting point, this study utilizes data from interviews with scientists as well as document analysis to examine the knowledge regimes in play in a project that concerns genetically-modified organisms (GMO). The debate around such research projects and the use of their results in society is generally heated. Böschen found that the epistemic cultures involved in the GMO-debate differed with respect to evidence construction. Thus, they are characterized as evidential cultures, referring to "ways of constructing explanations and the structure of argumentation" (p. 512). Moreover, three forms of evidential cultures were identified, conceptualized as Restrictive evidential cultures (e.g. molecular biology), Holistic evidential cultures (e.g. ecology), and Evaluative evidential cultures (e.g. environmental medicine). This study highlights how specific aspects of the 'machineries of knowledge construction' are given emphasis in interdisciplinary research, depending on where tensions and conflicting views occur. With reference to Knorr Cetina's definition of epistemic cultures as cultures that 'create and warrant knowledge', the study by Böschen shows how principles for warranting knowledge come at high stake in new fields where knowledge is contested, and that forms of justification then becomes an important aspect of the epistemic practices.

In recent years researchers have started to use the concept of epistemic culture also for analyzing knowledge practices in more applied fields. One study that deals with conflicting epistemic cultures in the context of professional practice is published by Mørk, Aanestad, Hanseth and Grisot (2008). This ethnographic case study investigates inter-professional knowledge production in a medical research and development department, which comprise different expert cultures such as doctors, nurses, radiologists, and engineers. These groups are analyzed as a constellation of distinct, but interconnected communities of practice, embedded in different epistemic cultures. Special attention is given to how new knowledge practices are created between the different established

communities and their specific 'machineries of knowledge production'. The study highlights how epistemic cultures in this context are not only diverging but also conflicting in ways that generate obstacles for learning across the respective communities of practice. The obstacles imply that cross-disciplinary knowledge production and learning are not unproblematic, and achievements are dependent upon meaningful and constant negotiations over roles, values and competencies. For instance, there were continuous economic, organizational and political disputes surrounding ownership of patients and procedures between the departments involved, and the groups of participants needed to negotiate how tasks should be shared and time prioritized. Mørk *et al.* conclude that obstacles to change and learning at the organizational level is rooted in different epistemologies, and that new knowledge which is challenging current practices in the respective communities is more likely to become marginalized. Hence, it is not sufficient to bring different groups of professionals together to foster new forms of knowledge production and practice. We need to take into account that every community is "part of a complex web of people, activities and material structures extending well beyond the immediate work context" (p. 12), which has national and often international outreach and which constitutes identities and ways of knowing in distinct ways.

Related studies of how different epistemic cultures come into play in work which involves different expert groups are carried out by e.g. Moisander and Stenfors (2009), who reports from a case study of the production of knowledge in strategic management research and shows how differences in epistemic cultures may complicate the communication and cooperation between academics and corporate practitioners, and by Bechy (2003 a,b) who examines how professional groups in a semiconductor equipment manufacturing company strived to share knowledge across their cultural boundaries as well as how cultural artifacts are used both for the sake of knowledge sharing and for the sake of preserving the distinctions between the professional groups.

Together, this strand of studies highlights the need for considering the diversity and discontinuity in the epistemic cultures and networks that different communities of practice are embedded in if we are to understand mechanisms of change in professional work and learning. Moreover, they point to how such cultures and network relations span across local, national and international boundaries. While people engage in knowledge practices in their local environments, they do so by activating and enacting knowledge relations that stretches way beyond these environments and which serve to give certain ways of acting authority and legitimacy in the immediate context. In addition, by means of information technologies, individuals may simultaneously interact with people and resources in

their immediate environment and with people and resources spatially and temporally removed from this setting. The concept of epistemic cultures and the network-oriented approaches provide analytic tools and perspectives to deal with these dimensions and to reveal their distinctiveness in different fields of practice. We notice however that while this perspective is widely used in studies of science, and to some extent used in studies of (multi)professional practice, it is hardly used in studies of education and learning in higher education. This is remarkable, as teaching and learning in higher education institutions intends to be research based, and many educational programs – at least at graduate levels – aim to introduce students to a field of research-based knowledge. While research on scientific practices has moved on from a disciplinary approach towards epistemic and more recently to trans-epistemic cultures, research on educational practices and learning is, when approached from a cultural perspective, still grounded in perspectives on disciplinary cultures. Even though the disciplinary approach gives important insights, there is a danger that the dynamism of knowledge practices and the complex mechanisms through which students become enrolled and engage with wider knowledge cultures fall out of scope.

Another issue that comes to the fore in the studies presented above is how the logics of science increasingly become intertwined with other logics in practical work, as a result of new relationships between science and society. For instance, different epistemic cultures and practices hold different relations to economic, political and other cultural instances, and have different strategies for bringing the results of their knowledge production into societal and economical life. This is increasingly also a concern in research on higher education systems and organizations (e.g. Bleiklie and Byrkjeflot, 2002; Bleiklie 2003). We will thus include a brief overview of a more recent strand of research that relate to cultures of knowledge and expertise, namely research on Epistemic communities.

Epistemic communities

Epistemic communities sometimes occurs as a buzzword in international policy making, related to grand, complex issues facing the world such as environmental sustainability, nuclear threats, and global warming. It is however also used more strictly by researchers as an analytical perspective to study the dynamic relation between expert knowledge and policy making. A significant contribution in this regard is the work by Haas (1992). He takes as a point of departure that technical uncertainties and the complexities of global problems have made international policy coordination

both necessary and increasingly difficult, and that expert communities – in his terms, epistemic communities – increasingly take significant roles in these efforts. Haas (1992, p. 39) defines an epistemic community as "a network of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area". Although epistemic communities may refer to professionals and experts from a variety of disciplinary backgrounds, they also have their distinct characteristics. According to Haas, they share 1) normative and principled beliefs (which govern the social action of community members), 2) causal beliefs (resulting from their analysis of practices which then elucidate the multiple linkages between policy actions and outcomes), 3) notions of validity (intersubjective, internally defined criteria for evaluating knowledge in their domain), and 4) a policy enterprise (a set of common practices associated with a set of problems).

Epistemic communities are different from, for instance, research groups in that they neither collect raw data nor make hypotheses; rather they interpret a holistic array of issues from varying perspectives. Their involvement in political decision making may include elucidating cause-effect scenarios and give advice about the likelihood of a certain course of action, defining state interest, and formulating policies for specific issues or areas of societal life. They employ a variety of methodologies and techniques and theories, including scientific methods. Although they are sometimes nationally framed, they increasingly operate on a trans-national scale. Here, workshops, seminars, conferences, and publication opportunities create environments for the formation and sustenance of epistemic communities. They provide decision makers with their interpretations of knowledge, which is agreed upon temporarily but also changing over time.

In one sense epistemic communities are spatio-temporally bounded, in the meaning that their existence is defined by a specific problem and its possible solutions (Adler and Haas 1992). However, their international institutionalization may be facilitated by the national political system of their establishment, and the 'products' of their engagement may have a longer life. Even failed ideas will often not disappear one and for all but rather be archived for future reinterpretation and consideration. Once their ideas or interpretations get accepted, their influence will continue through processes of institutionalization. They also play a role in policy diffusion through their networks and members.

As noted by Meyer and Molineux-Hodgson (2009) in their introduction to a special issue on epistemic communities, the concept of epistemic communities draws on several lines of research within the social studies of science, such as Kuhns notion of paradigms and Fleck's idea of thought

collectives. It is also related to different ways of conceptualizing communities within the social sciences (ibid.), however distinct in its way of highlighting the epistemic dimension. Compared with the notion of epistemic cultures, they note that epistemic communities refers to a more distinct group of people who actively or intentionally form a network with the aim of creating and advocating certain types of collective knowledge in the intersection between research findings and policy making. The purpose and character of this type of expert work is thus more distinctive for epistemic communities than the more long-term set of practices and belief systems that guide knowledge production in epistemic cultures. Hence, the binding forces take another character, as do the spatial and temporal outreach of the collective practice. However, following Meyer and Molineux-Hodgson (2009), also epistemic communities produce knowledge. The difference is that this knowledge has to provide solutions to specific problems. Knowledge has to be useful, and a prime issue for evaluating success is the degree of policy receptivity. A common feature is that both epistemic cultures and epistemic communities are heavily concerned with validating and warranting knowledge, based on scientific methods and approaches.

In recent years, researchers have used the concept of epistemic communities to examine how new participants and communication patterns become constitutive for epistemic communities and hence contribute to blur distinctions between scientists and professionals, experts and lay people. For instance, Akrich (2009) examined how online communities formed around health issues by way of discussion lists. She points to how these discussions emerge from people's opposition towards health professionals which led to formation of new communities with the purpose of systematizing and formalizing a body of knowledge. Akrich describes how the formation started as a type of community of practice, which developed into epistemic communities as their knowledge efforts became a form of political action. This study points to how new relations between science and society may be reflected in new relationships between expert groups and clients, which is highly relevant for the education and work of professionals.

Another analysis of interest for this review is presented by Lorenz-Meyer (2009), who examined how epistemic communities are conceptualized in the three areas of political science, organizational studies and feminist epistemologies, and identifies historical contingencies and timings; type of epistemic projects and technologies; and epistemic responsibilities as core dimensions to be included in an analytical framework. Then laboratory practices are examined in relation to the described heuristics of epistemic communities. By showing how epistemic communities stretch beyond laboratory activities in time and space, Lorenz-Meyer argues that the laboratory does not

constitute an epistemic community as such. Rather it is better understood as a partial site in which the 'histories, dynamics, genderings and interrelations of epistemic communities with other knowledge projects' can be traced. The contribution of this paper is hence a conceptual and methodological one, pointing to the need for researchers to investigate communities across locations and occurrences if we are to understand their dynamic configurations.

In a wider perspective, both epistemic communities and epistemic cultures are embedded in shared or interlinked large-scale machineries of knowledge construction, in which their respective knowledge practices also provide a dynamic basis for the others' work. Hence they are *trans-epistemic* (Knorr Cetina, 1982) in the sense that they span across different locations in time and space, in that they involve different types of practitioners, in that they are concerned with the political and the epistemic; and with the social and the technical. They are thus inherently dynamic, contested, and in constant development. However, as pointed out by Meyer and Molineux-Hodgson (2009), there is a remarkable lack of studies that focus on how epistemic communities (and, we would add to this, epistemic cultures) come into being and how they are maintained. The enrolment and learning of students and newcomers is a prime issue in this regard. Except from a study carried out by Molineux-Hodgson herself (2006), in which she analyzed how community mechanisms are embedded and reflected in scientific texts, very few studies have focused on students' learning in this perspective. More research is needed that examines the interrelation between the continuation of epistemic cultures and communities and the initiation of newcomers, in a way that account for the historical as well as the transforming character of such communities.

Seen together, research on epistemic communities point to how knowledge production and verification today is dispersed across a variety of sites and often interlinked with the political and economical dimensions of society. One interesting aspect in this regard is the emergence of new organizations and community formations which operate on different levels in society but at the same time form networks and linkages that constitute the larger 'machineries' of knowledge construction. Knorr Cetina (2007, p. 367) uses the concept of *Macro-epistemics* to bring attention to the increasing knowledge verifying units and organizations that "take on specific knowledge-related tasks in larger knowledge contexts". This may, for instance, be organizations responsible for synthesizing evidence and setting standards for knowledge-based practice in specific domains, such as the Cochrane centre, or agencies that certify knowledge products and expertise on a multi-national scale and hence contribute to national and international regulations. Epistemic communities may themselves take on roles as macro-epistemic agents, and also serve to create links

between different types of agents, products and responsibilities. As noted by Meyer and Molineux-Hodgson (2009), epistemic communities "work through connectivity, perhaps not so much by connecting people, but by connecting objects and subjects, people and places, production and distribution, individuals and collectives, histories and futures, the virtual and the concrete." In this sense, the world is getting smaller and bigger at the same time, in ways that are highly significant for how we understand and develop cultures of knowledge and learning in higher education. To increase our understanding of the formation of expert communities and cultures in today's society we need to focus research efforts on how these connections are made and remade, and how people come to participate in knowledge cultures that increasingly have global connections and outreach. Hence, higher education institutions and practices should become core sites for such investigations.

CONCLUDING REMARKS

In sum, the review of research strands and studies undertaken in this report points to several gaps and future needs in the research on knowledge cultures and learning in higher education. First, the review shows a growing divergence between studies of student learning on the one side and studies of knowledge cultures and expert communities on the other. While the latter strand has developed over time and today is informed by the concepts of epistemic cultures and communities, the former seems to be grounded in perspectives of disciplinary cultures. Moreover, while research on epistemic cultures and communities is influenced by ethnographic and network-oriented approaches, the research on student learning is dominated by individualist methodologies. Several consequences of these discrepancies can be imagined. One is that current research on student learning maintains a static view of knowledge, and fails to account for the shifting, transforming and multiple dimensions of epistemic engagement. Another is that, as a consequence of conceptual models and research designs, the space and time frames in which learning in higher education is studied, seems rather restricted. Studies tend to emphasize formal teaching and learning activities as they are described in curricular documents and enacted in local contexts, and have to a minor extent taken wider circuits of knowledge and multiple forms of participation into account. Hence, we lack insights in how students come to participate in wider epistemic cultures; in the mechanisms that facilitate enrolment or create barriers for participation; as well as in the role of educational programs in linking and facilitating multiple and even simultaneous modes of engagement. When learning has been the focus of research, knowledge seems to be reduced to a type of 'frozen

content' in educational activities, rather than being approached as dynamic processes and relations that constitute expert communities and enroll newcomers into such communities.

In the first part of this review, we referred to Haggis' (2009b) conclusion that research into learning in higher education has failed to account for 'the fleeting', 'the distributed', 'the multiple' and 'the complex' aspects of learning. The further examination showed that, even if these dimensions are better accounted for in research on professional learning, the studies that do so are mainly focused towards work settings and hardly ever to processes and practices in higher or professional education. Moving to part 2, the review showed that alternative conceptual models and research approaches do exist, but these are predominantly employed within science studies and research on expert communities, and almost non-existent in empirical research on students' knowledge practices and learning in higher education. We will thus argue that a productive way forward would be to bring perspectives and approaches from research on epistemic cultures and communities into research on student learning. This would allow for an increased understanding of critical dimensions in students' enrolment and participation in expert cultures, and at the same time contribute to fill the gap in research on epistemic cultures and communities that concerns how these come into being, are (re)produced and sustained.

Recently, researchers have started to introduce perspectives from Actor Network Theory and other socio-material perspectives to the field of educational research (Fenwick and Edwards, 2010; Sørensen, 2009). However, with the exception of Nespor's work (1994, 2007) these are not employed in higher education settings. Moreover, to address the issues above, we need to account for knowledge in ways that go beyond the common ways of employing ANT. We need to understand knowledge processes as such, and how knowledge becomes a constitutive force as well as a "capacity to act" (Bechmann *et al.*, 2009). The insights from research on epistemic cultures and communities shows how these processes are dynamic, recurrent and in transformation. While research in higher education has focused on themes like recruitment and retention, and research on professional learning has emphasised students' initiation into single and historically given communities of practice, the situation today calls for research that examines the processes by which academics and students become enrolled, and manage to stay enrolled, in dynamic and changing knowledge cultures. Inspired by the studies of Knorr Cetina (1999) and Kastenhofer (2007), cultures of knowledge and learning in higher education should be investigated as to the temporal and spatial scale of their activities; the ways in which they de- and recontextualize knowledge; their ways of dealing with complexity and uncertainty; their ways of handling the unforeseen; and their degree of inter- and transdisciplinary reflexivity. For instance, what is the spatial outreach of the learning

activities in a given programme? To what extent is knowledge represented in universal and 'global' forms, with a "capacity for decontextualization and recontextualization, abstractability and movement, across diverse social and cultural situations and spheres of life" (Collier and Ong, 2005, p. 11)? To what extent is its validity and use more experience-oriented and generated from below in locally bounded communities? And, to what extent is ways of employing knowledge geared towards unification or towards differentiation?

Methodologically, attention should be focused towards knowledge settings and processes rather than towards individual practitioners and bounded activities. This may also contribute to our understanding of modern societies as such, because, as Knorr Cetina (1999, p.8) states; "the study of knowledge settings becomes a goal in the attempts to understand not only science and expertise but also the type of society that runs on knowledge and expertise". At the same time, epistemic cultures and practices cannot be studied at a single analytical site. The examinations and discussions in this report have pointed to how epistemic cultures and practices today often are dispersed across a variety of sites, in which people come to participate in multiple ways and where the processes and products of different activities are interlinked in complex 'machineries' of knowledge construction. Hence, there is a need for research that investigates knowledge cultures and processes across and between sites, and which also traces knowledge-related connections between sites and societal levels.

In a wider perspective, this report has pointed to how the epistemic is interlinked with the political and economical dimensions of society, and often premised by processes emerging from other sectors. For research in and on higher education, it is of special importance to understand how education and learning is constituted in interplay between knowledge cultures and the political and societal transformations in society that higher education is embedded in. To do so, it is necessary to extend the scope 'upwards' and 'downwards' simultaneously, in order to account for dynamics of change and stability as they play out in and between transnational, national and organizational levels. Pfister (2009) argues that studies of governance in the EU, in his case the Lisbon Strategy, would benefit from a twofold scope of analysis which draws on research on governance and science studies respectively. Historically, governance studies have focused on system levels and to a large extend been concerned with macro analysis of policies and their institutional implications, while science studies on the other hand have focused on research practice on a micro level, with research groups or teams as their unit of analysis. To better grasp the forces and mechanisms that constitute higher education institutions and practices today, the governance perspective may be extended downwards to also include meso- and micro-level analysis, and studies of knowledge processes and

relations should be extended 'upwards' to account for wider ecologies of knowledge and how connections are made between different sites and levels in the larger 'machineries' of knowledge construction. The concept of epistemic cultures, with its focus on dynamic knowledge settings and its more recent notion of macro-epistemics, provides opportunities for conceptualizing and researching knowledge across time and space, and forms an important contribution to this research agenda.

1) The work with this report was organized in several steps. Teklu Abate Bekele carried out the initial literature searches based on criteria set by the project team, and systematized studies on knowledge cultures in a first draft. Monika Nerland and Karen Jensen has extended and developed the review further, and worked out the discussion and line of arguments provided in this final version.

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APPENDIX: REVIEW APPROACH

Part 1 of this report is primarily included for background purposes, to relate the research on knowledge cultures to previous research on learning in higher and professional education. For this part, we have drawn on previous research reviews within the respective areas, especially those provided by Haggis (2009 a,b), Lahn and Jensen (2006) and Lahn (2010).

The second part examines research on knowledge cultures in higher education and professional contexts, and aims to reveal how conceptions of knowledge cultures as well as their operating forces are in transition in ways that transform conditions for learning in higher education. This part is based on our identification and systematization of relevant research, which was conducted in four stages. Firstly, the criteria for the identification and selection of relevant studies were carefully developed. Secondly, a list of potential research literature sources was developed. Thirdly, manual and electronic searches for studies were conducted. Finally, methods of analyzing selected studies were identified. These review stages are expounded in the subsequent paragraphs.

Criteria development

For focus and relevance purposes, the following criteria were developed to identify and select relevant studies for the review. First, studies should have considered higher education institutions such as colleges, university colleges, and universities, or the knowledge cultures of expert groups that emerge from these institutions. Second, studies should address cultures of knowledge and / or learning in such institutions. This means that studies that focus higher education governance, management, policy making, funding, and other macro and meso-level issues are not the concern of this report (for studies that address the governance and regulation of knowledge on macro and meso levels, we refer to the project's sister report on the Europe of knowledge provided by Gornitzka *et al*). Third, as the aim is to understand how knowledge cultures emerge, play out and are conceptualized in research on knowledge practices and learning, focus is primarily on empirical studies and not on theoretical investigations within the sociology of knowledge and/or philosophy of science. At the same time, we have been concerned to include studies that take different approaches to conceptualize cultures of knowledge and learning. In this regard disciplinary cultures formed a starting point, as this framework has achieved authority in research on higher education and provide a reference from which research on knowledge cultures has developed. Fourth, we have looked for studies that account for network relations or wider ecologies of knowledge in respect of

analytic focus. Finally, only works published in academic journals, books, conference proceedings, and official websites is considered.

Source identification and search approaches

Principal sources of literature included online and print academic journals in the area of higher education and professional learning. The ERIC database was an important source to identify relevant studies. Other sources included books and encyclopedias. Generally, academic journals, books, and databases were identified as possible literature sources.

Manual and electronic searches. A manual search for relevant research studies was conducted from the sources identified above. This search was especially appropriate to locate relatively older publications that do not have online versions. The manual search firstly considered academic professional databases, books, and encyclopedias. The search also included the identification and selection of studies from online databases which did not require the use of keywords and search engines, e.g. journal websites. Focus was however on online resources as publications are increasingly becoming available online and for free. The Google search engine, ERIC, and Bibsys databases are used for the search. The following and their combinations are the major keywords used: *Epistemic cultures, epistemic cultures in the professions, epistemic cultures and professional studies/and professional learning/and academic disciplines, disciplinary differences, disciplines, disciplinary differences and professional learning/knowledge, disciplinary cultures, professional cultures/learning/ studies, professional studies and disciplines, academic tribes, knowledge cultures, learning trajectories, modes of knowledge production.*

The electronic search located some more journal articles and other materials available over the web. Overall, the manual and electronic searches identified a sizable number of studies that deal with cultures of knowledge and learning which were considered for further analysis.

Analytical approach

The analysis of the identified literature took place in several steps. First, the different studies were organized as to how they explicitly or implicitly conceptualized cultures of knowledge and/or learning. This resulted in three main categories of research on knowledge cultures, namely disciplinary cultures, epistemic cultures, and epistemic communities. Then they were grouped in relation to their type of research questions and design. As a third step, the studies within each of

these categories were examined as to their units of analysis, core analytical concepts, and findings. In this step, we also considered similarities and differences between the studies in how processes of knowledge production and distribution are accounted for, and how this relates to the enrolment and engagement of practitioners. Based on these examinations, we selected a set of studies to be more explicitly discussed in the review, which together shows the variety as well as the type of contributions in the respective strands of research. These studies where organized and presented under the headings of the different types of knowledge cultures.