Designing for the
Unknown

Didactical Design for Process-based Assessment in Technology-rich Learning Environments

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Abstract

This thesis is based on a study of the development of education through the innovative use of process-based assessment in technology-rich learning environments in teacher and nurse education. The study of process-based assessment addresses the aim of creating a better understanding of the shift in emphasis from teaching to learning with regard to theory and practice. The research questions address the use of process-based assessment, and how the social relationships and issues of content can be understood in technology-rich learning environments. A methodological approach involving design-based research was found to be especially applicable. The study was designed in three iterative didactical design cycles for process-based assessment in which the first and third cycles were analysed. The empirical material comprises qualitative semi-structured interviews with teachers and students and questionnaires with students. The empirical material was analysed through inductive thematic analysis. The theoretical analyses in the comprising articles are mainly based on Bernstein's theoretical framework for studying social relationships through concepts of symbolic power and control. For understanding change, with regard to the shift in emphasis from teaching to learning, the analysis is taken to a meta-level by applying Bernstein's concept of pedagogical device.

The results outline the shift in emphasis from teaching to learning from both a theoretical and practice perspective. Theoretically, the shift in emphasis from teaching to learning is based upon a shift in symbolic power and control for teachers. In practice, the shift of symbolic power and control between the teacher, student and content outline considerable overlaps between teacher-student, teacher-content and student-content. The overlaps highlight the empirical contribution in this thesis through the concept of "process" that is understood as a negotiation between teacher-student, teacher-content and student-content. The weakening symbolic power relationship made a multi-dimensional analysis of the teacher-student-content relationship possible. Theoretically, the shift of symbolic power outlines a process of recontextualisation of a new discourse for teaching, learning and assessment. The multi-dimensional analysis highlights the theoretical contributions to understanding the concept of discourse from Bernstein's perspective through which the content and context create the discourse. For practice, process-based assessment frames the notion of designing for the unknown. Designing for the unknown is considered as a framework based upon a set of rules through which teachers and students adapt to a problematising approach in teaching, learning and assessment.

List of papers

The thesis is based on the following articles, which will be referred to in the text by Roman numerals:

I.   Bergström, P., & Granberg, C. (2007). Process diaries: Formative and Summative assessment in on-line courses. In N. Buzzetto-More (Ed.), *Advanced Principles of Effective Online Teaching: A Handbook for Educators Developing E-Learning*. Santa Rosa, California: Information Science Press.

II.   Bergström, P. (2010). Process-Based Assessment for Professional Learning in Higher Education: Perspectives on the Student-Teacher Relationship. *International Review of Research in Open and Distance Learning, 11*(2).

III. Bergström, P. (2011). Shifting the Emphasis from Teaching to Learning: Process-based Assessment in Nurse Education. *International Review of Research in Open and Distance Learning, 12*(5).

IV.   Bergström, P. (Under review). Bridging the distance in teacher education: Teachers' perspectives on process-based assessment. Submitted to *Technology, Pedagogy and Education*.

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Introduction

This thesis is based on a study that is set in the context of a long-term ongoing initiative to develop education by using and studying the innovation of process-based assessment in technology-rich learning environments. Developing education by process-based assessment is a matter of both theoretical and practice issues. Process-based assessment as educational development raises questions such as: What is process-based assessment about? What indicates the notion of a process? Why is process-based assessment used instead of process-based teaching or process-based learning? It was found that process-based assessment considers a wider range of questions in society with regard to lifelong learning and how such educational practice is designed. Further, the innovation of process-based assessment has helped to integrate related ideas about teaching, learning and assessment in such settings. The study takes its starting point from an experienced problem in a technology-enhanced learning course. This problem was highlighted during students' independent studies when teachers felt they lost contact with students' work and their learning process (Österlund, Granberg & Bergström, 2006). In order to address the problem, a number of projects were initiated in order to study process-based assessment in higher education. The innovation of process-based assessment involved three cycles of didactical design during a period of five years. The didactical designs relate to the teacher-student relationship with regard to issues of communication, interaction and documentation of content. Such didactical designs can be regarded as models or prototypes that enact processes of teaching, learning and assessment, or, in other words, designs for social relations (Selander & Kress, 2010). The notion of design for social relations is an implicit consequence of didactical design, which is an important aspect in the aim and research questions of the thesis.

Didactical design

At the outset of the development, didactical design was used to illustrate possible points of communication, interaction and documentation in the teacher-student relationship. Researchers from the field of teacher education have focused on the concept of didactical design based on curriculum theory (Hudson, 2008, 2011), design and multimodal theory (Rostvall & Selander, 2008; Selander & Kress, 2010), and didactic in relation to design (Loveless, 2011). Another group of researchers use cognitive theory for thinking about instructional design, and particularly the question of "how" to teach (Reigeluth, 1999). The theory of instructional design outlines a practice of instructional designers that focuses on the best methods for reaching the

learning goals. With regard to behaviours and strategies, Morrison and Anglin (2012) argue that the more fine-grained design, the more successful it will be in practice. Such approaches highlight structured guidelines to teachers about successful strategies for reaching the learning goals (Reigeluth, 1999). Similar to this, didactical design and instructional design highlight the increased use of technology that embraces new approaches to ideas about teaching, learning and assessment. In this thesis, the conceptual framework of didactical design is taken as it offers a broader educational perspective that takes account of social relations between teachers and learners in contrast to rather narrow focus, on learners and learning, which is offered by the framework of instructional design.

Didactical design is considered an aspect of teaching in technology-rich learning environments from at least two perspectives. In the first perspective, didactical design derives from the humanistic philosophy (Klafki, 1997, 2000) of the teacher-student-content relationship in the north and central European tradition of didactics and didactical analysis (Hudson, 2002). Hudson demonstrates a journey from the interest in Klafki's (2000) didactical analysis towards a design approach in his later writing. Hudson argued that Klafki downplayed the notion of design, which he related to (*metodik*) rather than didactics (Hudson, 2008, 2011). The humanistic philosophy in didactics is considered a base that highlights design as an aspect of teachers' higher order thinking skills and as a creative practice in our time and society. Moreover, Hudson (2011) outlines didactical designs for technology enhanced learning that consider the classical didactical questions of what, how and why in relation to technology, content, culture, and students. The second perspective highlights the fact that our society is changing with regard to globalisation, and because new modes of communication and interaction patterns create needs for new approaches for understanding learning (Rostvall & Selander, 2008). Didactical design from this point of view is based upon theoretical perspectives of design and multimodality on learning. This theoretical perspective involves both the role of the brain from aspects of selection and variation, and aspects of the social world from human sign creating activities (Selander & Kress, 2010; Selander & Svärdemo-Åberg, 2009). Selander and Kress (2010) define didactical design as a future striving activity for creating meaning that highlights aspects when both teachers and students design the process they are part of. Accordingly, the meaning of didactical design is similar but reveals different kinds of issues depending on what theoretical starting point is taken. The idea of didactical design in this thesis has emerged from the designs of process diaries and process-based assessment in practice. In general, the approaches lead to the didactical relations between the teacher, student, content, and wider practice. In particular, the social relationships between the teacher and student have been in focus. This thesis contributes to the

ways of thinking about didactical design by using Bernstein's (1977, 2000) social theory of symbolic power and control. The next section looks at the underpinning ideas of didactics. The theoretical understanding of didactics is used to justify perspectives on the relationships in the didactical designs.

Didactics

Didactical theory is used to understand the underpinning philosophy of didactics that strongly influences the ways of thinking about didactical design. At the outset of this study, Klafki's (1997, 2000) concept of *didaktik* from the German tradition was considered. Hudson argues that *didaktik* in the German context "can be described as systematic reflection about how to organise teaching in a way that brings about the individual growth of students" (Hudson, 2007, pp. 106-107). Organisation of teaching and learning is related to the didactic triad that highlights the relationship between the teacher, student and content. Uljens (1997) considers the didactical triad as "'teacher education didactics", which does not problematise the societal and cultural context in advance of subject didactics. Hudson and Meyer (2011) picked up this limitation and integrated the instructional process, the institution and the wider society as a frame of the triad. Another frame is considered as the increasing use of technology in education. This frame is separated since technology-rich learning environment plays a crucial role in this thesis. Furthermore, the didactical triad has supported the understanding of what is educational content, how the teacher and the student are percieved in different traditions for teaching and learning, and issues that frame and affect these relationships.
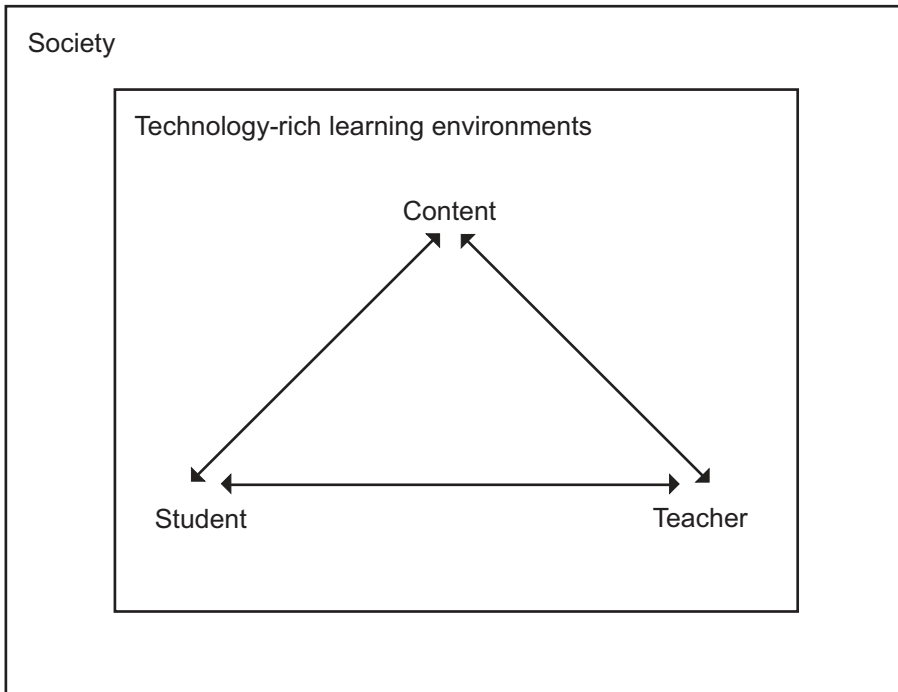
Figure 1. Relationships within and outside the didactical triad

Figure 1 highlights the relationships in the didactic triad that supports the understanding of the teacher-student-content relationship in relation to technology-rich learning environments and the wider society. Hudson (2002) uses the triad from a perspective of the teacher's role to illustrate and think of the complexity of this relationship. He argues that since teaching does not necessarily imply learning for students, the teacher has a role to orchestrate activities for students' studying. Hudson concludes that "the didactic relation is a relation to another relation, and concentrating on this *set* of relationships is the core of a teacher's professionalism" (Hudson, 2002, p. 49). Thus, if the focus is turned to the teacher-student relationship in particular there is always an implicit relationship to the content. Moreover, Hudson emphasises and acknowledges Klafki's (2000) concept of Didaktik Analysis as useful for his analysis. Klafki's (2000) ideas about the teacher-student-content relationship were suitable in this study since they emphasise the social relationship between the teacher and student and their interactions based upon a humanistic philosophy. In considering the student-content relationship, Klafki's thoughts were derived from the work of Herman Nohl and Erich Weniger particularly by leaving the dominant US

curriculum tradition of seeing content as nonnegotiable (Hudson, 2002). Hudson summarises the didaktik tradition with regard to the student-content relationship as "the value of any content can only be ascertained with reference to the individual learner in mind, with its attendant past and anticipated future" (Hudson, 2002, p. 46). The ideas about content highlights teachers and students as "actors" based upon freedom and independece. With regard to freedom and independence, such a decentralised curriculum tradition gives teachers a precondition to practice their profession as teachers individually. In the non-negotiable objectivist curriculum tradition, teachers and students are considered as "factors" based upon well defined manuals and guides. The illustration of the didactic triad with regard to the ideas of the teacher-student-content relationship in relation to the shift in emphasis from teaching to learning, indicate an elaborated approach when considering the relationships. The elaborated didactical relationships are considered as overlapping sets as illustrated in a Venn diagram in Figure 2.
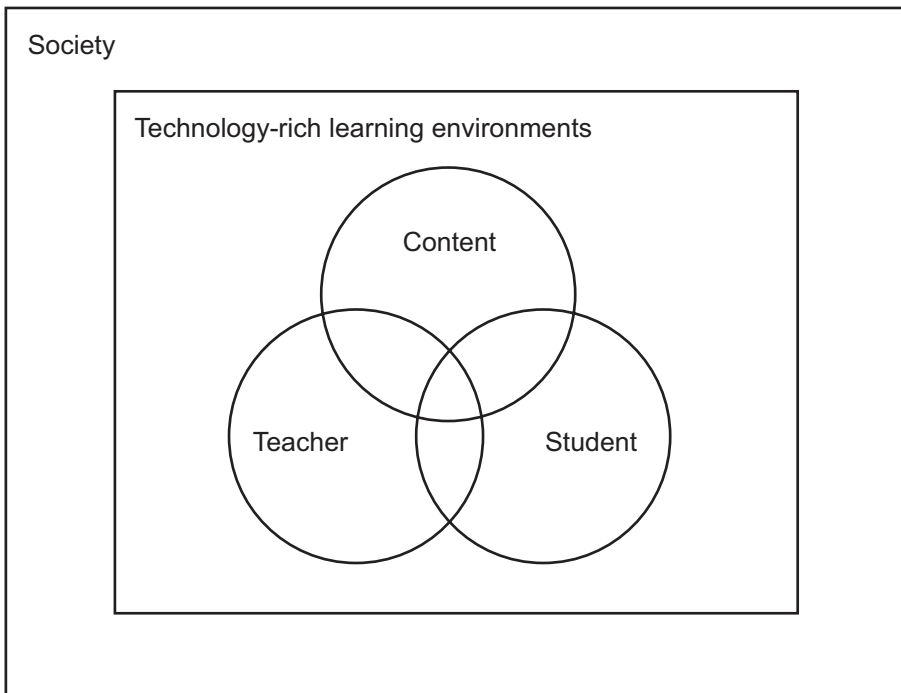
Figure 2. An elaborated design of the didactical relationships

Figure 2 demonstrates an elaborated illustration of the didactical relationships with considerable overlaps between the three categories. The rationale of Venn diagrams supports my consideration of social relationships based upon the above literature. The student-content and the teacher-content relationships indicate that both teachers and students have a role in the content issue. The teacher-student relationship considers the humane philosophy in the social relationship indicating a shared role. The multi-dimensional teacher-student-content relationship indicates an environment of sharing and negotiation. This section outlines a perspective on didactics as a multi-dimensional teacher-student-content relationship framed by technology-rich learning environments and the wider society. In order to provide a richer understanding of didactical design in technology-rich learning environments, attention is turned to the concept of design.

The concept of design

Kirkwood (2009) reports how technology has changed teachers' practice. In teacher-centred teaching, teachers have a role to produce teaching material. In contrast, student-centred teaching highlights teachers' practice through aspects of design. Yelland, Cope, and Kalantzis (2008) found design as an especially suitable framework for teachers' way of planning and thinking in technology-rich learning environments. The concept of design is strongly influenced by the work of Simon (1996). Simon is regarded as the first who considered design as a science (Mor & Winters, 2007). Simon's (1996) way of thinking of design is attended to an engineering context addressing the notion of ideas through artefacts. Artefacts are considered as something artificial, aimed at supporting humans in their daily life, for example educational technologies. The artificial world is in contrast to the natural world, wherein a tree is no more or no less than a tree. In the artificial world the environment is considered from a system of an inner and outer environment visible through an interface. One example of an inner and outer environment is how educational technologies are used in teaching and learning. This separation between the natural world, that is the natural sciences, and the artificial world developed by man becomes strong when we consider the questions asked. The natural sciences highlight questions based on the notion of "how things are" in contrast to the artificial sciences, which highlight the core of the design philosophy of "how things *ought* to be" (Simon, 1996, pp. 4-5). How things ought to be highlights the definition of design as, "Everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (Simon, 1996, p. 111). Considering teachers and students as designers, this definition indicates a shared and non-authoritarian relationship when someone designs. Thus, in technology-rich learning environments this definition of design is

understood as a perspective on design that involves both teachers and students as designers, in other words didactical designers.

Aims and research questions

The aim of this thesis is to contribute to a better understanding of the shift in emphasis from teaching to learning in higher education based on the increased use of technology for teaching, learning and assessment. This aim is studied from both theoretical and practice perspectives through the intervention and development of didactical design for process-based assessment. The focus is on teachers' and students' experiences of the social relationships in this condition of teaching, learning and assessment. This thesis contributes to creating a better understanding through three part-studies in which the study takes its starting point in the following research questions:

- How do teachers and students understand process-based assessment for learning in technology-rich learning environments?

- How can the teacher and student relationship be understood in process-based assessment for learning in technology-rich learning environments?

- How can issues of content be understood in process-based assessment for learning in technology-rich learning environments?

The research field

This chapter is structured around Bernstein's (2000) two fields for recontextualisation as a frame. Bernstein considers both an *official recontextualising field* and a *pedagogic recontextualising field* (Bernstein, 2000, pp. 33, Bernstein's italic). Thus, in the first section the official recontextualising field is used for describing how states outline the policy agendas and incentives for changing practice. The agendas and incentives are used for understanding the teacher's role, the student's role and the issue of content. In the next section, the pedagogic recontextualising field is divided into four parts. The pedagogic recontextualising field highlights how practice responds to changed policy in which literature was chosen with regard to questions such as: Is this shift happening? Why is it happening? What issues demonstrate such a shift? Since this shift is studied through the intervention of process-based assessment the selection of literature is not focused only on assessment. Complementary literature for understanding technology-rich learning environments, teaching, learning, and assessment is added to this review. The first part considers how technology-rich learning environments are understood in relation to didactical design. The second part focuses on the reconceptualisation of learning by looking at different theories for learning. The third part looks at teachers' design from a perspective of reconceptualising teaching. The fourth part considers a broad overview of assessment, including concepts for assessment by demonstrating the current understanding and design of assessment.

Policy from the European Commission and Sweden

The official recontextualising field in Europe regarding the shift in emphasis from teaching to learning is based on at least two broad policy agendas: Lifelong Learning and the Bologna Process. A Lifelong Learning agenda is considered as the broad framework for continuing education and professional development during the career of employees. Lifelong learning involves eight key competencies of importance in the transitions between different careers during one's life. The fifth key competence—learning to learn—demonstrates orchestration of the learning process and skills to construct new knowledge from previous knowledge:

> *"This competence includes awareness of one's learning process and needs, identifying available opportunities, and the ability to overcome obstacles in order to learn successfully ... Learning to learn engages learners to build on prior learning and life experiences in order to use and apply knowledge and skills in a variety of contexts: at home, at work, in education and training." (The European Parliament and the Council of the European Union, 2006, p. 7)*

The Bologna Process focuses on higher education and can be considered as an aspect of the Lifelong Learning programme. The Bologna Process has gradually created an agreement between the systems of education with regard to the mobility of students and teachers in Europe and the shift from teacher-centred teaching to student-centred learning (EHEA, 2010). Further, the Bologna Process promotes comparability between programmes, courses and grades in Europe. It is important to note that the Bologna Process is based upon a similar structure, and it does not aim to achieve identical comparability. The similar structure is based upon quality frameworks implemented in practice as learning outcomes. In Sweden, the Bologna Process was introduced into the higher education system in 2007 (EHEA, 2007). At the local level of the universities it became a reform in course syllabi with regard to learning outcomes. Reforming the syllabus is particularly highlighted in documents from the Leuven and Louvain-la-Neuven communiqué in 2009 (EHEA, 2009). The focus on competencies in learning outcomes (Karseth, 2006) is a tool for aligning education across Europe. However, another important issue is the shift in emphasis from teacher-centred teaching to student-centred learning, which was generally pointed out in the London 2009 communiqué (EHEA, 2007) and was specifically emphasised in the Leuven and Louvain-la-Neuven communiqué (EHEA, 2009). The student-centred learning agenda highlights empowerment in the student role, new approaches to teaching and learning, and the rapid development of technology. For understanding the preconditions further, Lifelong Learning and the Bologna Process are associated with the national IT policy in Sweden and how the educational community responds to such initiatives.

Information and Communication Technologies (ICT) has been considered as a catalyst (Brown, 2006) for reaching the policy aims above. In Sweden, the integration of ICT in society was accomplished at a policy level in 1993 (Karlsson, 1996). This was a response to the global changes with the US in a leading position. However, technology creates "massification" of higher education possible (Davies, 1998) through the affordances of scale, which means that more students can be reached with less resources (Laurillard, 2008). The scalability of higher education means in practice that lectures are replaced with student-centred learning, including increased responsibility and self-assessment skills. Another notion of scalability is the possibility of reaching new groups for courses and programmes in higher education through courses on the Internet (Mårald & Westerberg, 2005). However, key challenges for higher education are still considered as a shift from a teaching paradigm to a learning paradigm by addressing diversity in learning (TRENDS, 2010), and flexible approaches to teaching and learning (TRENDS, 2005). Further, flexible approaches to teaching and learning build upon the notion of independence of time and place, which means that

in today's society people need a reliable IT infrastructure and high-speed Internet connections (Fransén et al., 2011). However, the contextual issues are not merely related to technology. Davies (1998) argues that the contextual issues in the shift from teaching to learning are affected by "regionalisation". Regionalisation highlights the localisation of the university and the particular needs in the region. These needs explain why some universities invest more in full distance education while others invest in blended-learning approaches. In summary, the implications of the policy on the shift in emphasis from teaching to learning explained that higher education institutions should aim for a view of knowledge based on competencies, and practices based on "learning" and "flexibility". In general, the policy initiatives frame how institutions facilitate their environments for learning, and indirectly how teachers frame the didactical design with regard to technology-rich learning environments, teaching, learning, and assessment.

Technology-rich learning environments

In the pedagogical recontextualising field, didactical design involves aspects of how teachers and students are active in handling technologies that frame and facilitate their learning environment. The phrase "technology-rich learning environments" is understood from two perspectives on environments in which teachers and students choose to use technologies for teaching, learning and assessment. Simon (1996) conceptualises the use of artefacts (technologies) in the artificial world as an interface of an inner and outer environment. This concept helped think of design in relation to technology. The inner environment of technology-rich learning environments constitutes the design and organisation of particular software applications. The outer environment highlights the surroundings, as the social relationships in which the inner environment is one part. Harmony in the educational practice indicates that the inner environment fits with the outer environment.

The inner environment

The inner environment of a technology-rich learning environment is important to consider since the design of the environment can affect communication, interaction and documentation. Simon (1996) outlines his thinking of the inner environment with an engine metaphor, where the designer of the engine decides if the engine, for example, shall prioritise top speed or power. Thus, the engine is designed with some kind of rule in mind. Similarly, software applications inside and outside education have different purposes, but they are not necessarily in opposition. Inside education,

learning management systems (LMS) are widely used at institutions and are priced for the capabilities of keeping track of student grades and attendance. In contrast, Paulsson (2008) argues further that LMS were developed for industrial training in contrast to learning. Further, Wilson et al. (2006) argue that the design of LMS is based upon predefined forums for discussion, student administration, and content locked to a particular course. The latter issue corresponds to the precondition of isolating resources from other resources, which corresponds with the notion of LMS as silos (Paulsson, 2008). The silo metaphor concerns limitation, wherein LMS do not communicate or interact well across system boarders. For example, if a student has a blog outside the formal environment the blog content is difficult to integrate into the formal environment.

Outside education, social software has received increased attention through its features of social, collaborative and sharing affordances. The sharing possibilities of social media applications support the possibilities to combine different types of resources and content in a new application. This notion of combining different resources outlines the features of mash-ups. Mash-ups are defined as web-based applications that combine content, presentations and functionality from different resources on the web (Ebner, Klamma, & Schaffert, 2010). Thus, mash-ups give teachers and students new possibilities to design their learning environment. Wild, Mödritscher and Sigurdarson (2008) introduce the concept MUPPLE that stands for "mashed-up personal learning environments". When students use a MUPPLE prototype they design their own learning environment that supports their individual trajectories.

Research has tried to combine the benefits in the structured LMS world with the less structured but creative mash-up learning environment. Technical standards are crucial when making such overlaps across system boarders. One example is the reported research of Severance, Hans and Hardin (2009) that demonstrate the IMS Learning Tool Interoperability (LTI). The IMS LTI is a standard for gaining access to external tools, for example a blog and from LMS through a browser. Such technical standards highlight the unknown needs of future users, which Fischer (2007b, 2011) considers from the theoretical concept of "meta-design" in software development. The principle of meta-design demonstrates the need to develop software applications in which users can integrate things that software developers are not aware of during the development. Such ideas highlight designs of the unknown that acknowledge a shift from product to process (Fischer, 2007a). Thus, in order to increase the possibilities for personalisation, there is a need at the software developer level to design open systems for reaching the notion of teachers and students as didactical designers. Therefore, when the system borders are blurred, the role of who

designs what and under which circumstances indicates new roles for teachers and students.

The outer environment

The outer environment uses Simon's (1996) metaphor of an airplane in the atmosphere. The power from the engine takes the airplane to different levels in the atmosphere where it performs differently in relation to air density, pressure and temperature. Similarly, software applications bring teachers and students into new atmospheres of social relationships according to the level of communication and interaction that inner environments afford. The outer environment is used to understand the relationship that is created in practice when teachers and students use technologies from the inner environment. Granberg's (2011) study uses discourse analysis for analysing the social relationships between teachers and students in teacher education when creating a pedagogical ICT discourse. The results point in the direction of a diverse design of digital individual development planning (IUP), blogs and e-Portfolios, since teachers from different academic subjects have different beliefs regarding teaching, learning and assessment. Kirkwood and Price (2012) argue that teachers' "conceptions" highlight abilities to form and understand designs of teaching and learning in technology-rich learning environments. They prefer an understanding in which teachers design student-centred activities for learning rather than designs that are based upon the belief that innovations are driven by technologies. Kjällander's (2011) study is based upon design theory of multimodality applied in studies on children and adolescents aged 6-17 years. The results highlight both teachers and students as didactical designers as a consequence of transformation and formation processes of unknown content in technology-rich learning environments. Therefore, issues of content become a difficult question in technology-rich learning environments. Based on Shulman's way of thinking, Koehler, Mishra and Yahya (2007) have developed a multi-dimensional model for technological pedagogical content knowledge (TPCK). The relationship between the three elements of technology, pedagogy and content in practice needs to be considered as a multi-dimensional relationship. They argue that "good teaching with technology requires understanding the mutually reinforcing relationships between all three elements taken together to develop appropriate, context specific strategies and representations" (Koehler et al., 2007, p. 741). Thus, the inner environment of technologies creates diversity in the space where technologies meet social relationships. In general, how individuals and groups of humans understand technologies shape diverse designs of the pedagogical practice. In particular, the use of technologies for creating meaning through different resources and new representations highlight the

notion of the unknown. This thesis takes the starting point of what is behind the diversity and the notion of the unknown by analysing the social mechanism in the teacher role and the student role in technology-rich learning environments.

Learning

This section has relevance since process-based assessment intends to support students' learning. For understanding the shift in emphasis from teaching to learning, researchers argue for a reconceptualisation of how we understand learning. The reconceptualisation of learning is strongly related to the teacher-student relationship with issues of educational content. This section provides a brief overview of the basic principles of the different theoretical apporaches to learning in relation to the teacher role. The reconceptualisation of learning in relation to teachers and students' work is demonstrated in the following learning theories: behaviourism, constructivism, social constructivism, and the socio-cultural perspective on learning. This is followed by a new and fresh perspective called designs for learning. The behaviouristic learning theory of Skinner mainly highlights the transfer of knowledge from the teacher to the student (Skinner, 1971). In behaviouristic teaching, the teacher plans and structures the educational material. The behaviouristic approach to learning price knowledge is characterised as the remembering and reproduction of facts. In contrast, constructivism focuses on how knowledge is created by the student (Marton & Booth, 2000). The constructivist principles to teaching strive to involve the whole student by developing their previous knowledge in relation to new challenges, which highlights a changed teacher role. Dalgarno (2001) argues that the teacher has a role to decide what to read but scaffolds and facilitates that process for the modification of previous knowledge and skills. Social constructivism is developed from the theory of Vygotsky and his theory of the zone of proximal development (ZPD) (Vygotsky, 1978). ZPD considers how a group of people can develop their current level of knowledge to a higher level of knowledge. Such learning is accomplished by collaboration with other students or through teachers' supervision. It is in this meeting that the zones of development can be created and further elaborated. Social constructivism is close to the socio-cultural perspective on learning, which is related to individual development in relation to society and culture (Vygotsky, 1978). In the socio-cultural perspective on learning, Lave (1993) argues that learning is situated, which means that we learn in and from situations. Thus, contexts have an important meaning for what kind of knowledge that is created. Contexts have meaning from tools—physical and virtual tools—since they support human thinking by our communication, interaction and collaboration (Säljö, 2000). Selander and Kress (2010) argue

that there is a need for a new conceptualisation of learning with regard to lifelong learning and lifewide learning. Such learning puts the learner in a new position considering the learner as an expert within their profession. The theoretical approach highlights the notion of "designs for learning" (Selander & Kress, 2010, p. 67) involving general aspects about how the learning environment is framed and specific perspectives of creating meaning during the students' learning process. In formal practices, Sellander and Kress illustrate such designs as cycles of transformation and formation for reaching a representation of the created meaning (Selander & Kress, 2010, p. 114).

Teaching

This section of the pedagogic recontextualising field uses the previous section on learning for further understanding the shift from teaching to learning by considering the teaching practice. Traditional teaching is considered as the knowledge transfer metaphor (Säljö, 2000). The knowledge transfer metaphor uses transmitter-receiver thinking outlined by Shannon-Schram and Chute in Wagner (1994). This communication metaphor demonstrates that it is the one who sends the information that is the initiator of the communication. Thus, traditional teaching—mainly organised as desk teaching—is understood to be the teacher as the transmitter and initaitor of the communication, while the student is the receiver. However, researchers argue that the very nature of learning is changing from hierarchical social relationships, teacher-centred teaching, and knowledge as transferring and remembering (Barr & Tagg, 1995; Säljö, 2000) to holistic, active and informal learning, diverse contexts, process-oriented learning, and learner-centred teaching (Barr & Tagg, 1995; Berendt, 1998; Laurillard, 2008; Schneckenberg, Ehlers & Adelsberger, 2011). Making such a shift has implications for abolishing teaching rather than learning (Carlgren, 2011). Carlgren strongly argues that if it is not teaching that is teachers' object, what is it then? For understanding this perspective and the dichotomy it raises, the concepts teaching and knowledge are further analysed in which Carlgren's text has influenced my thinking. Carlgren uses the history of the school systems in relation to the changed and expanded concepts of learning and knowledge to identify three recontextualised teaching practices: teaching a course; teaching for understanding; and teaching for capabilities (Carlgren, 2011, pp. 37-41). In the perspective of teaching a course, the behaviouristic approach to learning prevails. Teachers often construct teaching from a predefined content of textbooks and their teaching is based on a plan that organises students' acquisition of transferred knowledge as clearly as possible. Teachers' planning could take a starting

point from questions such as "How many pages must the students accomplish today?"

Teaching for understanding generally involves a constructivist approach to the teacher-student relationship. In particular, the knowledge concept is broader because teaching is focused on students' understanding by involving them in, for example, discussions of different solutions. Questions in the teachers' planning involves, for example, "When students acquired this section what is their understanding *behind* this performance?" Teaching for capabilities is understood as teaching in relation to learning outcomes. This understanding of teaching involves situated knowledge, which per definition become diverse. Teachers' teaching involves aspects of design of the learning practice for supporting students' development of reaching learning outcomes. Teachers could ask: "What must students be able to accomplish in their profession?" In summary, both Niemi (2009) and Carlgren (2011) take a position that the shift in emphasis from teaching to learning will not abandon teachers' teaching. They argue strongly for a reconceptualisation of the concept of teaching in relation to changing concepts of knowledge and learning. Thus, Carlgren's (2011) and Niemi's (2009) work is important in this thesis because it offers an important contribution about teachers' professional practice as teachers. This thesis contributes to further development in the understanding of teaching in technology-rich learning environments by using findings based on an analysis of symbolic power and control for interpreting teachers' professional practice further in the shift in emphasis from teaching to learning.

Assessment

This section relates to assessment and the different shapes and approaches to formative assessment in the shift in emphasis from teaching to learning. Literature was selected from the well-established research and knowledge field about classroom assessment (Black & Wiliam, 1998a; 1998b; Shepard, 2000). Classroom assessment has developed the current ways of thinking about the principles of formative assessment. Formative e-Assessment is a development of formative assessment that addresses it in technology-rich learning environments. Literature on formative e-Assessment was selected with an aim to understand how and if assessment change both as practice and in theory when the context is changed from the classroom to technology-rich learning environments. This chapter contains six sections about the diverse perspectives on assessment.

The differences between assessment and examination takes their starting points from an established definition, where assessment is related to judgements of someone's work, while examination involves some standardised procedures mostly on written exams (Knight, 2006; Stobart,

2008). For understanding the developed practice of assessment in such environments the assessment terrain is mapped with a starting point in three dichotomies for assessment.

Table 1. Three dichotomies of assessment (Russel, Elton, Swinglehurst & Greenhalgh, 2006).

Dichotomy	Assessment	
1.	Positivist	Interpretative
2.	Summative	Formative
3.	Product	Process

Table 1 shows three dichotomies derived from Russel et al. (2006), which has implications for further understanding the shift in emphasis from teaching to learning through assessment. In the first dichotomy, the positivist and interpretivist concepts are based on different claims of truth (Lincoln & Guba, 1985). The claims of truth highlight the beliefs about assessment that can be interrelated to the two other dichotomies. The second dichotomy highlights different aims of the assessment such as to control or to support students (Taras, 2005). The third perspective focuses on assessment of a product or the process for reaching the learning outcomes. The product approach was desirable in the industrial society; however, consequently the information and knowledge society has new demands on assessment in relation to the changed concept for learning (Frånberg, Dunkels & Hällgren, 2011).

Positivist and interpretivist assessment

The positivist claims of truth are based on correspondence theory in an existing and known reality giving the correspondence principle if A then B. The impact of correspondence theory in assessment is based on assumptions such as assessment matches teachers' teaching (Boud, 1995). Moreover, the teacher-student relationship with the positivist approach argues for "fairness through uniformity" (Russel et al., 2006, p. 467) based on concepts of validity and reliability. In contrast, the interpretivist approach to assessment is based on naturalistic principles. Naturalistic principles outline a constructed and complex reality with claims of understanding truth (Lincoln & Guba, 1985). In practice, the teacher-student relationship focuses on contextual knowledge, student-tutor negotiation, balance in power, responsibility, and "fairness in diversity" (Russel et al., 2006, p. 467).

Accordingly, the interpretivist philosophy to assessment has similarities with the understanding of design.

Summative assessment and formative assessment

In the second dichotomy, the two concepts of summative and formative assessment is scrutinised with an aim to understand their purpose and function. In a case study of an online course in higher education, Lindberg, Olofsson and Stödberg (2010) report that the course design and the assessment criteria were part of the process of creating meaning for students. They argue that the context is framed by both a summative and formative assessment practice. Summative and formative assessments have a nature of different "stakes"—either low stake or high stake. In Roos' (2005) study, he uses and analyses the concept of "stake" in a perspective of an investment. A high-stake assessment is an investment with possible social consequences. In positive terms a higher grade on an exam gives the student possibilities to achieve a high status position compared to those who failed. In contrast, a low-stake assessment does not affect a student's social life as such.

Table 2. Benefits and challenges for holistically assessment approaches.

Approach	Nature	Benefit	Challenges
Summative assessment	High-stake assessment	Match student performance in relation to criteria and qualities	Difficult to avoid surface learning and memorising
Formative assessment	Low-stake assessment	Highlights a concept for the relationship between teaching and learning	Need to problematise the process aspect

Summative assessment (or final exams) is regarded as the most common form to assess and certify students' performances in courses and programmes (Boud, 1995; Boud & Falchikov, 2006; Weaver, 2006). For governments, summative assessment has a function to communicate the level of competence since the main focus of summative assessment is to certify or warrant achievements (Knight, 2002). However, since summative assessment does not have a similar relevance as formative assessment in this thesis, the following section focuses on different matters researchers have considered about formative assessment.

Formative assessment

In general, this section looks at how formative assessment has developed over a 20-year period. In particular, formative assessment is considered to be a low-stake practice that highlights communication and interaction between teachers and students. Taras (2005) argues that the similarity between formative and summative assessment is that the teacher makes the judgement in relation to the learning outcomes for a course. Formative assessment as such has other purposes then summative assessment since it is part of teaching and learning (Black & Wiliam, 1998a; Black & Wiliam, 1998b; Black, 1998). The notion of being formative in the assessment has roots in evaluation. In the use of formative evaluation, Scriven (1967) argues for the principle of making improvements after the judgement is accomplished. By taking such a principle to students' learning process researchers understand this judgement as feedback. Feedback is understood as a fundamental tool for communication in the teacher-student relationship (Sadler, 1989). Further, Sadler's (1989) reasoning is based on the notion that feedback creates opportunities for interaction between the teacher, student and curriculum through goals and criteria. Accordingly, the formative process involves both an aim to improve students' learning, an aim of improving teachers' teaching, and well-defined educational content.

The student perspective

In the emphasis on formative assessment for improving students' learning, a key principle is that teachers provide and share information with the purpose of guiding the student in a particular direction (Black & Wiliam, 1998a; Gipps, 2002; Lauvås, Havnes & Raaheim, 2000; Torrance & Pryor, 1998; Yorke, 2003). For understanding formative assessment further, the formative process is isolated to three basic building blocks (Torrance & Pryor, 1998). This way of thinking has been helpful for illustrating the formative assessment process from a student and teacher perspective.
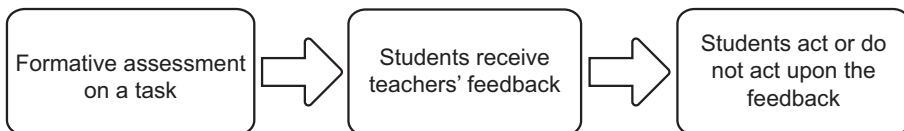
Figure 3. The process of formative assessment from a student perspective.

Figure 3 illustrates the basic principles of the formative assessment process. In this perspective three processes are insulated from the classroom context. The process starts in the box to the left by formative assessment on a task. In principle, formative assessment is related to tasks with criteria. The next step involves interaction, where the teacher and the student meet through the teachers' feedback. In the classroom context, the feedback is transferred within a rather complete transformation process through oral communication (even though there could be many issues making it complicated). When students receive the feedback, they can decide to act or not act upon teachers' feedback. From this process two issues emerged: the meaning of feedback and criteria.

The process of making learning outcomes explicit with regard to competencies and criteria highlights both the formative assessment practice and the social relationships. Weaver (2006) found that teachers' feedback to students need to be specific and with guidance containing rich explanations. To be specific tends to be an emerging trend that has the meaning of focusing on the assessment criteria. From students' wish for specific feedback, Torrance (2007) argues that the formative assessment practice is problematic. In the social relationship, Torrance found that teachers support students by interpreting the criteria for them if the criteria were not transparent. He argues that such practices promote instrumentalism in learning. Further, the feedback became an issue when considering to what extent the criteria was met or not. Torrance (2007) addresses such practice as "assessment as learning" with teaching methods based upon "criteria based coaching". Thus, what frames practice has implications for teachers' and students' communication and interaction.

The teacher perspective

In the second perspective on formative assessment, attention is turned to teachers, since formative assessment involves modification of teachers' teaching derived from students' feedback (Black & Wiliam, 1998a). Accordingly, Hattie found that students' feedback to teachers is the single most important variable for improving teaching and learning (Hattie, 2009).

| Formative assessment on a task | → | Teachers recieve students' feedback | → | Teachers adapt teaching and learning activities |
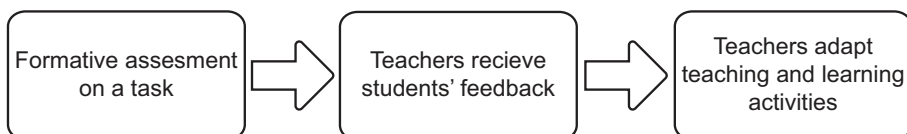
Figure 4. The process of formative assessment from a teacher perspective.

Figure 4 illustrates the teacher's perspective in the formative assessment process. This process starts in the first box to the left. Teachers conduct formative assessment on a task. From this assessment, teachers receive feedback to what extent students performed in relation to teachers' teaching. From this information teachers can evaluate and adapt teaching and learning activities, and in the long-term perspective adapt the curriculum. Carless (2007a) addresses this aim of improving teaching and learning as pre-emptive formative assessment.

In the work on formative assessment, Black & Wiliam (2009) refer to this as involving "moments of contingency". These are seen to be based on four features extracted from a definition of formative assessment: a combination of teaching and learning; decisions that result in actions based upon collected evidence; the involvement of both teachers and students in decision-making processes; and what the foundation of the decisions are based upon (Black & Wiliam, 2009, pp. 9-10). In summary, the development of classroom-based formative assessment still addresses the core value of facilitating students' learning. Some issues disturb the established formative assessment practices by calling into question the role of criteria, and also how students and teachers are involved in the decision-making process. However, formative assessment in technology-rich learning environments has become the focus of increasing interest and this is discussed in the next section.

Formative e-Assessment

e-Assessment is a broad concept covering activities wherein computers are used in assessment that involves the design and delivery of assessment (JISC, 2007). A recent review (Stödberg, 2011) identified five categories of research topics about e-Assessment within 76 articles: implementation, tools, reliability, learning environment, and cognitive skills (Stödberg, 2011, pp. 7-10). The researcher summarises the number of articles for each category in relation to summative and formative assessment. The majority of the articles focused on the learning environment and formative assessment by teachers who studied their own practice. Formative e-Assessment as an aspect of the learning environment involves, for example, issues such as feedback to students and students' autonomous abilities in relation to interactive questions. With regard to feedback to students, another literature review (Hepplestone, Holden, Irwin, Parkin & Thorpe, 2011) reports on the last 10 years of research on feedback in relation to technology. Five areas were identified ranging from using technology to publish, and producing feedback for computer-assisted assessment and peer assessment.

Whitelock (2010) demonstrates eight examples of using web 2.0 in assessment. These range from multiple-choice polls to approaches involving

the use of e-Portfolios. Interestingly, Whitelock notes that it was only in one of eight examples where "negotiated assessment" was found (Whitelock, 2010, p. 15) in contrast to e-assessment as a device for control. However, the study by Pachler and collegues on formative e-assessment concludes that "formative e-assessment is incredibly complex, since it requires the delicate orchestration of social, pedagogical and technological systems" (Pachler, Daly, Mor & Mellar, 2010, p. 720). Their reasoning is based upon moments of contingency (Black & Wiliam, 2009) highlighting issues of the unknown. The researchers demonstrate how the unknown content became an issue in relation to moments of contingency in assessment when, for example, photo documentation was used. Such documentation highlights an aspect of e-Assessment where students choose and create content for assessment. In another study (Daly, Pachler, Mor, Mellar, & 2010), the social and technical issues are emphasised further in moments of contingency. Hence, the relationship of technologies and social aspects creates something difficult to define and grasp with regard to potential actions, and issues of communication, interaction and documentation. Furthermore, Kjällander's (2011) study addresses assessment issues in technology-rich learning environments for compulsory school. An interesting finding is that teachers are confronted with the assessment of unknown content because teachers are not aware of what content students might draw on in the digital environment. The study by Roos (2005) involves the context of distributed online tests in higher education. In the findings two matters were of particular interest for this study: assessment and new approaches to learning indicate that assessment practices highlight what counts as knowledge or knowing; and there is a risk that online assessment can benefit training and not learning. In addition to the sections on formative assessment, the next section considers issues of diversity in relation to the dichotomy of product and process.

Product and process

In the third dichotomy, Russel et al (2006) focus on the relationship between product and process.

Table 3. Benefits and challenges of product and process assessment

Approach	Nature	Benefits	Challenges
Product assessment	Take starting point in positivist and behaviouristic principles	Supports accountability and grading	To secure that the test measures what it assumes to measure
Process assessment	Highlight interpretativist principles to knowledge and learning	Support students' creativity	To acknowledge issues of diversity and the unknown further

Table 3 shows the positive aspect of product thinking in assessment, which relates to purposes of accountability and grading. In the pedagogical practice, a product is desirable for demonstrating students' performance and achievements. Moreover, the product has different intentions depending on what claims of truths teachers' teaching are based on. From critical voices, assessment of products is related to positivist arguments such as predefined outcomes in advance, constituting the prevailing context in society of accountability (Stobart, 2008). In the criteria-based approach, reaching the criteria is considered as the product (Torrance, 2007). If students fail to reach the criteria, they receive feedback over and over again focusing on what they need to modify for reaching the criteria. In contrast, interpretivist thinking outlines the difficulty of predefining learning. From this perspective, Russel et al. argue that "it is often not possible to assess *final* learning outcomes, in which case it may be only the process of learning that can be assessed" (Russel et al., 2006, p. 467). Researchers often stop here without identifying key concepts to demonstrate assessment of the learning process. Frånberg et al. use a game analogy, arguing that the winner is not the student with the most points, but "the one who could create and recreate truth, meaning and reality; the one who had the power and ability to adapt to change and generate the best storyline" (Frånberg et al., 2011, p. 2). Accordingly, assessment of the learning process involves students' creativity

in their performance of a product. This thesis contributes to increasing the knowledge of the process aspect of assessment and defines what the process is about. Furthermore, at least three practices of assessment have been identified, which aim to interrelate the process and product thinking that to some extent outline formative assessment features further.

Three practices of formative assessment

Formative assessment has a strong relationship to teaching and learning processes. This section looks at the process aspect of assessment in teaching and learning through three similar practices: assessment for learning, learning-oriented assessment and process-based assessment.

Table 4. Benefits and challenges of different practice-oriented methods for assessment.

Approach	Nature	Benefits	Challenges
Assessment for learning	Situated in classroom environments	A concept for practice in relation to learning	Difficult to separate assessment from good teaching
Learning-oriented assessment	Derived from campus-based teaching	Assessment activities are constructed from a set of principles	Possible consequences in learning because strong focus on criteria
Process-based assessment	Situated in online environments	Acknowledge student-generated content	Theoretical constructions are needed

A common theme in Table 4 is the emphasis on learning during the assessment process. Assessment for learning is related to formative assessment but tends to generally focus on social contexts, and in particular on situated classroom interactions (Stobart, 2008). Because of this situated nature, assessment for learning is related to assessment activities that are designed with students' learning in mind (Berry, 2008; Black, Harrison, Lee, Marshall & Wiliam, 2003; Black & Wiliam, 2006; Boud, 1995; Stobart, 2008; Whitelock, 2010). The situated nature highlights the diversity of methods in the assessment, for example learning diaries, portfolios,

observations, and projects. However, learning-oriented assessment (Carless, 2007b) was conceptualised from another aspect of diversity with regard to formative assessment. Teachers with a constructivist approach considered formative assessment as good teaching, while teachers who preferred lecturing did not have time for formative assessment. In online process-based assessment, Granberg (2009) demonstrates such an issue as a social matter in the teacher-teacher relationship. The researcher uses symbolic power to explain the relationship between teachers who price process-based assessment in relation to teachers who do not consider it as teaching and learning. However, the framework for learning-oriented assessment, possibly interrelated to process-based assessment, contains three crucial principles: assessment tasks should be designed to stimulate sound learning practices among students; assessment should involve student actively in engaging with criteria, quality, their own and/or peers' performance; and feedback should be timely and forward-looking so as to support current and future student learning (Carless, 2007b, p. 60). This approach aims to conceptualise, synthesise and articulate students' learning (Keppel & Carless, 2006). In addition, process-based assessment adds a dimension of a longitudinally practice with a focus on students' learning process over time (Hudson et al., 2009).

Positioning

At the outset of this chapter, questions are raised about whether the shift in emphasis from teaching to learning is actually happening and what issues are there that demonstrate such a shift. There are issues that explicitly and implicitly address such a shift particularly from a perspective of practice. Explicitly, research on issues of teaching addresses teachers' practice when shifting from teaching to learning. Implicitly, technology-rich learning environments contribute to policy aims of creating greater flexibility in time and place. Further, technology-rich learning environments highlight practices that involve informal learning outside educational institutions through the use of social media applications and changed practice of teachers and students towards those of didactical designers. The practice of assessment demonstrates an increased focus on process aspects of assessment that involve issues of diversity and unknown content. In order to understand the shift in emphasis from teaching to learning further, this thesis is therefore positioned between theory and practice. Hence, theoretical contributions related to the shift in emphasis from teaching to learning focus on didactical designs of the unknown based upon the analysis of social relationships. The practial contributions focus on further understanding the notion of process in such a shift.

Research Methodology

This chapter presents the methodology for this thesis. Blaikie (2000) argues that a methodological approach is a broad concept that covers the whole research process. The research process addresses issues ranging from the knowledge claims of the research to issues with regard to how the research should be accomplished. During the research process a number of methodologies have been considered such as grounded theory and hermeneutics. Grounded theory (Glaser & Strauss, 1967) was appealing according to the inductive approach that was chosen. The focus of the chosen research design, however, was not aimed to generate new theory. As a result grounded theory was not chosen. In hermeneutics (Ödman, 2007), I was inspired by the hermeneutical helix or circles that involved levels of interpretation between theory, observations and the researcher. Hermeneutics could have been a choice, but I had difficulties justifying my previous experiences in the interpretations. As a methodological framework Instead I found the approach of design-based research (DBR) especially applicable. The DBR methodology struck me with the idea of working with iterative cycles for developing both theory and practice equally. The iterative cycles supported the consideration of the development of education through process-based assessment as a practice in relation to the research questions about the social relationships and issues of content. Thus, the methodological choice of choosing DBR as a methodological framework was not clear at the outset but was later found as a proper rationale for this thesis.

   This chapter contains seven sections. The first section takes its starting point from the methodological approach of DBR. The methodological approach involves a presentation of the iterative design cycles that highlight how things ought to be (Simon, 1996). This approach is two-folded since it involves both a practice and theoretical perspective. For demonstrating the whole picture, the practice development is outlined together with the theoretical considerations in the second section about didactical design. Since this research has grown from local development at a department to a wider development at the university, the story involves parallel narratives of development. These parallel narratives can mainly be found in the third section of this chapter. The fourth section outlines the informants and how the empirical material was collected. The fifth section demonstrates how the inductive method for analysis was chosen. Based on the reasoning in the fifth section, the sixth and seventh sections highlight issues of validity and ethics.

Design-based research

The methodology of design-based research is under debate. Van den Akker identified four sub-domains of DBR: curriculum, media and technology, learning and instruction, and teacher education and didactics (Van den Akker, 1999, pp. 3-5). This thesis is positioned between media and technology, and teacher education and didactics. The early adopters of DBR conducted design experiments in laboratories. When the researchers found it difficult to isolate all of the variables in relation to the natural settings, they moved out to practice (Brown, 1992). According to the naturalistic preconditions, the debate outlines a diverse nature with regard to the methods for studying these contexts. Van den Akker identifies approaches with similar methodologies such as design studies, design experiments, design research, developmental research, formative research, action research, and engineering research (Van den Akker, 1999, p. 3). This diversity creates what Wang and Hannafin (2005) address as "hybrid methodologies". The diversity in the methodological approach is derived from five characteristics of DBR in general: pragmatic; grounded; iterative, interactive and flexible; integrated; and contextualised. The key characteristic of DBR is developing both theory and practice (Wang & Hannafin, 2005) with the aim of bridging the gap between research and practice (Van den Akker, Garavemeijer, McKenny & Nieveen, 2006), since it is a problem that research does not reach out to practice, and the practice does not benefit from the research.

In the early nineties, a design experiment was used for specifying successful designs. For example, Collins (1992) studied five different teaching sessions based on five different technologies for mediating seasons (for example a TV programme and a software application) in relation to the problem of students' difficulties of learning seasons. This approach searched for causal mechanism based on the performance of the innovation such as the TV programme (Sandoval, 2004). Thus, if a teaching session with TV programmes worked well it became the solution for learning seasons. Further, Collins, Joseph and Bielaczyc argue that a particular design can never be specified enough due to the variation in "the participants needs, interests, abilities, interpretations, interactions and goals" (Collins, Joseph & Bielaczyc, 2004, p. 17). Moreover, this variation highlights the complexity of the naturalistic settings and the methodological concerns about the logic of the research. Barab and Squire (2004) argue for a theory-grounded approach that indicates distinguished DBR from laboratory experiments or evaluations. In the field of educational psychology, Sandoval (2004) argues that the methodology in DBR builds upon a precondition of "embodied conjectures" for an intervention. The argument for embodied conjectures in relation to theory considers what designers think, or guess, both in practice

and in theory. Thus, embodied conjectures are based upon a belief that any innovation has roots in theory. Further, diSessa and Cobb (2004) argue that researchers tend to follow their instincts—a subjective meaning in the scientific work—which are separated from theory, as a general language for understanding its meaning.

According to the above text, conducting DBR means that practitioners and researchers develop an innovation from a problem or question identified in practice. The relationship between practitioners and researchers is equal. The practice shall benefit as much as the research, which addresses the developmental aspect of DBR. The approach for conducting research on didactical design has similarities with the approach of conducting research on human computer interaction (HCI). This means that when the problem or question is identified the development process follows similar principles. The principles are based upon a design prototype that is assumed to solve the problem or question. The prototype is developed in collaboration with the practitioners and thereafter tried out in practice. Further, the researchers study the intervention through cycles of development. This means that iterative cycles are planned and evaluated. The study becomes iterative because after each cycle the material is analysed for developing the prototype further in collaboration. In the second cycle, new material is analysed for further development and then put into practice for a new cycle. In this study, the designed prototype is regarded as the didactical design for process-based assessment.

Didactical design of the innovation process-based assessment

This part presents the implementation and development of the didactical designs of process-based assessment. The text is divided into a rational that follows the research process with regard to two design cycles. However, before attention is paid to the first, second and third cycles of design, a brief history of the development of process-based assessment is outlined. This history is part of the rational for understanding the development of the didactical design in the first design cycle.
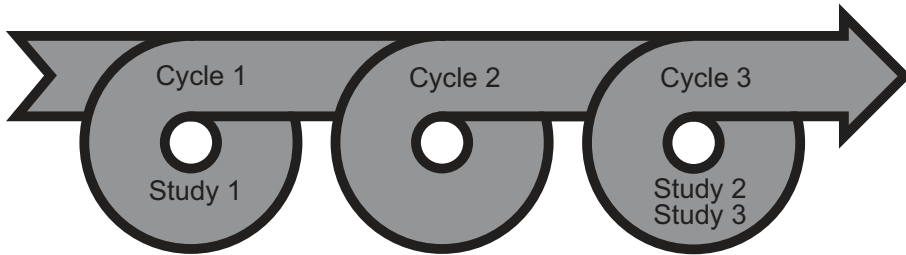
Figure 5. Iterative cycles.

Figure 5 illustrates the cycles when each part-study was developed and conducted. Each cycle revealed issues that gave new insights into the educational development. This approach became successful for extending, modifying and restructuring the didactical designs. The modification in each design revealed social relationships that were the focus of the analysis. The design process makes teachers' and students' interaction and communication visual. Making such issues visual became crucial for answering the research questions of this thesis.

Process-based assessment was first designed in the autumn of 2003 in a five-week course at 25% study pace called "Methods for net-based learning" organised by the Department of Interactive Media and Learning at Umeå University. Process-based assessment was in a format of process diaries distributed through editable documents in the platform FirstClass for collaboration and communication. This course focused on in-service teachers' professional learning by developing teachers' teaching on the Internet. The course contained both synchronous communication and interaction on campus, and asynchronous communication and interaction online. Österlund, Granberg and Bergström (2006) highlighted the fundamental problem of both in-service and pre-service teacher education in the asynchronous mode. This problem was based upon a course structure that involved tasks with start and stop dates without sufficient contact during the learning process. Teachers became assessors of a product with limited insights in the process for reaching the product. During students' asynchronous learning the lack of contact in the teacher-student relationship created a fragmented notion of students' work and knowledge process during the task. Process-based assessment was developed for bridging the gap in the teacher-student relationship, which addressed issues of assessment in students' creative process. The first two cycles of design outline the local development illustrated in a didactical design for process-based assessment, influenced through the summative and formative purposes of assessment.

The first design cycle

In the first design cycle, the research took its starting point in a didactical design for process diaries in distance teacher education. The first design cycle was important for understanding how teachers and students understand process-based assessment (first research question). The first design was developed between 2004-2005 (Paper I). The didactical design outlines two phases considering a practical problem of bridging the intellectual distance between the teacher and the student within a conceptual lens of formative and summative assessment. Accordingly, the format of process diaries highlights a double purpose of formative and summative assessment.
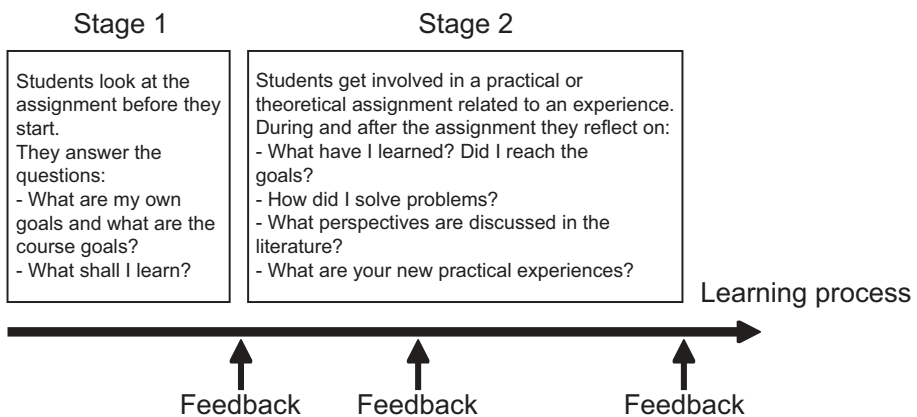
Figure 6. The first didactical design in two phases (Bergström & Granberg, 2007).

As Figure 6 illustrates from a practical perspective, the didactical design takes its starting point in the course goals and two questions. The instruction in the design highlights content issues in the relationship between the course goals and students' personal goals in the course. Students are asked to describe what they assume they will learn during the course. Teachers give feedback on students' texts. In the second stage, the design of the reflective activity was diverse with expectations of documentations and reflections both during and after the students' actions in an assignment. A key activity in the teacher-student relationship for bridging the intellectual distance was feedback. Thus, teachers frequently give students feedback during their work, and it is therefore important that students write regularly. At the end of the assignment, students reflect on and analyse what they have learned and whether or not the course goals have been reached. This process

involves the responsibility of the student, that is the importance for students to analyse problems and express how they have solved them. In the theoretical perspective, the systematically research outlines the research question of how teachers and students understand process-based assessment (Paper I). This question was developed by combining the summative and formative purposes in relation to the aim of getting insight into students' creative process. The uniqueness with the DBR approach allows the possibility for development together with a new cycle. The research in the first cycle highlighted a need for a didactical design in three phases, which became the main development in the second cycle. This development gave new insights into the process of development when a theory was applied.

The second design cycle

Looking in the rear-view mirror, the development of the third step in the didactical design contributes by emphasising the social relationships further. This development was conducted during the spring semester of 2006. The third step involved a developed design that explicitly illustrated the teachers' and students' points for interaction and communication during the process. The second cycle builds upon a local course development project at the department. This project is peripheral to this thesis but needs to be mentioned since it is a part of the development of the didactical design studied in articles. From the local development project, Österlund et al. (2006) argued for a development of the practice towards a stronger emphasis on students' knowledge process and the learning outcomes in the course. Österlund et al. (2006) created an elaborated design based on Blooms' revised taxonomy (Anderson & Krathwohl, 2001) involving two dimensions: a knowledge dimension and a cognitive process dimension. The knowledge dimension is divided into four categories that increase in abstraction from factual knowledge (less abstract) to conceptual knowledge, procedural knowledge and meta-cognitive knowledge (most abstract). The cognitive process dimension is divided into six categories that increase in complexity: from remember (less complex) to understand, apply, analyse, evaluate, and create (most complex).

Table 5. The second didactical design in three phases.

Start by reading the course goals for the assignment according to the definition

A. Describe your previous knowledge in the area "aim" in the document file.	B. Show practical or theoretical assignments in the course.	C. What did you learn? In the tab "process page 1 and process page 2".
Describe your previous knowledge within the subject with support of the following:	During the course you have solved practical or theoretical assignments that you have sent to the "task conference". From the assignments you have achieved new knowledge and experiences in relation to the goals for the assignment.	1. Decide by yourself five comprehensive key concepts with a starting point in the course literature, which describes your thinking in relation to the course goals. (Remember)
1. Concepts and specific details about the subject that you are aware of. (Factual knowledge)		2. With the support of your five key concepts, describe your new knowledge in relation to your previous knowledge. (Understand)
2. Describe your knowledge and your understanding of how the subject is related to other coherences such as theories and models. (Conceptual knowledge)	You will receive feedback and grades on the assignments. The feedback's purpose is to visualise knowledge gaps in relation to the course goals in the assignments.	3. How is your chosen key concepts related? (Apply)
		4. Describe how you can acquire new knowledge in relation to your five key concepts. (Create)

Table 5 shows the didactical design with three phases. The first phase highlights students' factual knowledge such as details with regard to what they study. The students received feedback during each phase. This phase includes conceptual knowledge where students are asked to think of concepts and theories they have been studying before in previous courses. The second phase involves students' daily work without addressing any particular category in the taxonomy. The documentation in this phase consists of students' practical and theoretical work with tasks and assignments. The third phase brings in the framework of the taxonomy with reflections that highlight the meta-cognitive knowledge category. The third phase also involves a structure based on the four categories from the

cognitive process. In practice students worked with the category "remember" in which they were asked to create key concepts in relation to the course literature and the learning outcomes. In the category "understand" students were asked to reflect upon their key concepts with a narrative about what they learned. In the category "apply" students were asked to analyse the relationship between their key concepts. The category "create" was most complex. Students were asked to look into new situations with regard to their key concepts. This was both a complex and abstract task for the students. Blooms' taxonomy was used as a conceptual tool for the teachers to frame students' thinking. Accordingly, the design was strongly influenced by cognitive theory, which probably affects the findings and influences the third design cycle. The expressions in the second design outline strong guidance that addresses the categories in Blooms' taxonomy. However, the third design cycle conducted in teacher education involved new teachers to the process of designing process-based assessment.

The third design cycle

The third design cycle is important for answering the second and third research questions (Paper II, III, IV). The former faculty of teacher education at Umeå University created a project in 2007 about individual development planning (IUP) and technology enhanced learning in teacher education as a response to this reform in schools (Granberg, 2009). During this period of time, the Swedish government created a law on IUP in Swedish schools. From here, the wider and international recognised concept of professional development planning (PDP) is used instead of the Swedish concept IUP. The aim of the project was to study how student teachers and teacher educators could work and develop digital PDPs in teacher education and how to increase the use of ICT in teacher education. Four departments participated in the project by involving teachers and students from the Department of Mathematics and Science, the Department of Swedish and Social Science, the Department of Education, and the Department of Interactive Media and Learning. The PDP project took its starting point from the experiences of process diaries and the elaborated didactical design of Österlund et al. (2006). Each department developed a design for process-based assessment based on the previous experiences. In the project, the participants from the departments used the structure of three phases but elaborated the content of each phase to their particular needs. The third design involved more aspects of formative assessment within each phase and across the whole process. Hudson et al. (2007) summarised a common structure of the didactical design in the project as shown in Figure 7.
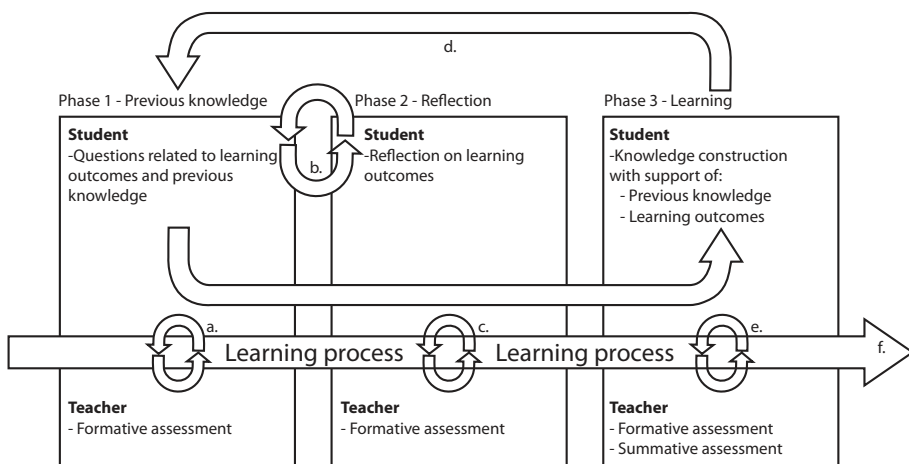
Figure 7. The elaborated didactical design.

Figure 7 outlines the didactical design for the third design cycle. This design involves three phases of students' previous knowledge, reflections and learning. From the perspective of practice, Phase 1 establishes the starting point of the course. In this phase, students describe previous life, work and study experiences upon which the teacher gives students feedback (a). In the middle of the course (Phase 2), students reflect upon their previous knowledge and the learning outcomes (b), which are followed by teacher feedback (c). When students finish the course (Phase 3), they summarise their learning in relation to previous knowledge and learning outcomes (d). The teacher provides feedback on the students' texts and makes a final judgement (e). Students focus on the documentation of their experiences, events and concepts, and over a period of time gain insight into self-awareness and learning, which constitutes the learning process (f). Figure 7 highlights teachers' issues of communication, interaction and documentation through students' asynchronous learning process. This illustration was helpful for creating questions in the theoretical perspective with regard to the second and third part-studies that use this design.

   The cognitive perspective from Bloom has less influence on the didactical design in the third cycle with regard to how the expressions in the design outline the teachers' beliefs. This design has more emphasis on formative assessment and the learning process based on the illustrated loops for communication and interaction. These illustrated loops for communication and interaction have turned my interest to the underpinning social mechanisms that such designs give implications to. For reaching the social

mechanism that underpins this didactical practice, the three research questions were helpful for demarcating the study. The research questions focus on: students' and teachers' understanding of process-based assessment for learning in a technology-rich learning environment; how the relationships between the teacher and student can be understood in process-based assessment for learning in a technology-rich learning environment; and how issues of content can be understood in process-based assessment for learning in a technology-rich learning environment. The described design cycles above involve three empirical part-studies conducted in the first and third design cycle. The next section describes the part-studies with regard to contexts, how the informants were chosen, and how the empirical material was collected.

Sample and data collection

Process-based assessment has been studied from a perspective of professional education involving both teacher education and nurse education. The first section presents the context of study and how the informants were chosen. The second section explains the semi-structured interviews and the questionnaires.

The three part-studies

This section presents each part-study through the contextualisation of the department with an overview of the group of informants and how data were collected.

Table 6. Data in each part-study.

Part-study	Year	Cycle	Faculty	Data
I	2006	1st cycle	Teacher education	27 student assignment analysed
				10 course evaluations
				3 interviews, teachers
II	2007-2008	3rd cycle	Teacher education	20 interviews, students
				12 interviews, teachers
				Questionnaire, 47 students
				Course documents/PDP template/curriculum
III	2007-2008	3rd cycle	Medicine	14 interviews, students
				8 interviews, teachers
				Questionnaire, 42 students
				Course documents/PDP template/curriculum

Table 6 outlines when the first and second part-studies were accomplished in teacher education. The context of teacher education was at the time for this study organised as a faculty for teacher education with five departments following a structure of the school subjects in compulsory school. Today teacher education is reorganised as a school of education. The faculty had a majority of campus courses compared to the amount of distance and blended learning courses. The very nature of campus-based courses is based on face-to-face communication and interaction in contrast to distance and blended learning courses that include the use of technology to enhance learning. In

the first part-study in the first cycle, focus was on the perspective of both teacher educators and in-service teachers. Since this study took its starting point from the relationship between summative and formative assessment, three teacher educators were interviewed once and the students written evaluation and assignment was used for analysis. The study focused particularly on the asynchronous communication. In the second part-study in the third cycle in teacher education, focus was turned to a blended learning project—the Satellite project. In the northern part of Sweden distance is a real issue. In the regions the municipalities have learning centres with facilities for studying at distance, for example rooms for videoconference lectures. With the Satellite approach the designers of the project used synchronous activities such as face-to-face teaching and online activities with web-based videoconference and live streamed lectures. The asynchronous activities contained e-mail communication, forums and process-based assessment. Process-based assessment was mediated through digital professional development plans (PDP). All teachers and students were asked to participate in the research. Three teachers agreed to participate in three interviews each, one teacher participated in two interviews, and one teacher participated in the background interview. Forty-seven students answered a questionnaire and 10 were chosen from a convenience selection for two interviews each. The course documents such as learning outcomes in the syllabus was used for analysis.

In the third part-study in the third cycle, the context of study focused on nurse distance education. The context of nurse education demonstrates a quick uptake of technology in courses and programmes. The teachers reported on a strategic decision taken at the department in 2002 for distance education. In 2002, the department was involved in a regional programme for increasing the amount of nurses in rural areas (Fåhraeus & Lundberg, 2002). This programme was Internet-based with both synchronous and asynchronous communication supported through a learning management system and web-based videoconferencing. The teachers participating in the research highlight this moment as a turning point in their careers, since it involved a new pedagogical thinking through the use of technology for bridging the distance in the teacher-student relationship. The course of study consisted of physical meetings at the university, synchronous webinars through videoconference and chat. The asynchronous activities involved e-mail communication, forums and process-based assessment through document files. The students were invited to interviews by replying to a questionnaire. Eight of 42 students were interviewed at the starting point of the process-based assessment. In the next interview six students were interviewed. The students studied two courses in parallel at 50% study pace and were part of a nurse specialist programme. Two teachers (N=2) chose

one of the two courses for process-based assessment and were interviewed on four occasions each.

Semi-structured qualitative interviews

The purpose of this thesis has been to create a better understanding of the shift in emphasis from teaching to learning in higher education based on the increased use of technology for teaching, learning and assessment. In the three part-studies, semi-structured interviews were used to collect the teacher and student experiences of process-based assessment. The interviews followed a structure of themes according to the didactical design and areas of teaching, learning and assessment, and the use of technology. The student questionnaire focused on students' educational background and their experiences of being assessed. All interviews were digitally recorded and transcribed before the analysis. In summary, the recorded material amounted to 55 hours. As demonstrated in Table 6, the interviews and questionnaires were complemented with course documents such as the written instructions in study guides or PDP templates.

Methods for data analysis

Schulman (2004) argues that it is the method that gives the research its particular order and how the research material will be conceptualised. This section explores the methods that have been used for analysing the qualitative material in this thesis. The argumentation takes its starting point from the concepts of deduction, induction and abduction. These concepts represent different claims of truth, where the deductive and inductive approach is considered as endpoints on a spectrum in qualitative research (Malterud, 2009). Using these interrelated approaches in the process of analysing qualitative data is preferred (Coffey & Atkinson, 1996; Malterud, 2009). In general, the claims of truth guide us to the kind of knowledge that can be derived from the empirical material under investigation. Fereday and Muir-Cochrane (2006) show a hybrid approach when deductive and inductive coding is used on qualitative information for generating themes. The deductive concept highlights the ideas of working with a theory driven code, while the inductive concept points at a data-driven code.

The concept of themes was derived and facilitated through the concepts of code, and the process of coding. Coffey and Atkinson (1996) argue that the code is a tool that guides us in the data. Coding can be considered as an analytical strategy since the coding can be applied to lines of text, segments or whole paragraphs of texts. This is a process that involves ability to organise, handle and retrieve the most meaningful piece of information. Accordingly, the coding process is the underpinning work for giving

information meaning. In particular, the deductive and inductive concepts were fundamental for my process of creating order and rigour in the coding of the empirical material. Depending on the approach and the tradition, the coding procedure will be both different but similar. The concept of coding is better described as a variation of approaches and ways of organising qualitative data. It should not be mixed up with the analysis process wherein the researcher obtained the results, but it is an analytical process to connect the codes to the data and to generate concepts that have an important function of giving rigour to what our data are saying. The process of coding involves a reduction of information that is the seed of a theme. Thus, the deductive and inductive concepts outline how the empirical material was coded, but also how theory is used in relation to findings.

Deductive coding

At the outset of the coding procedure the deductive approach was considered. The deductive approach takes its starting point from theory, which gives a particular understanding of the material. Crabtree and Miller (1999) report on the approach to create a template based on priori statements. Priori statements are based on prior research and theory, which outline the deductive approach as a theory guided strategy. A priori approach highlights per definition the disadvantage of the possibility to confirm what already exists. Since the meaning of this research was to understand the social relationships and the context further, it was not appropriate to study process-based assessment from predefined concepts, since it would create a meaning that was not inline with the research purpose. For the research purpose the inductive approach was found to be useful.

Inductive coding

The inductive approach for anlaysis takes its starting point from the data, and the concepts that are possible to derive from the data. The inductive coding of the emperical material for this research was feasible since the purpose was to understand the underpinning principles of process-based assessment with regard to the three research questions. However, Fereday and Muir-Cochrane (2006) guided my thinking of creating rigour in the inductive analysis. In research rigour supports knowing how the research has been accomplished in the data analysis. For demonstrating rigour focus was turned to the coding process. One issue of rigour is at what level the empirical material shall be analysed such as at a paragraph level or in the very details of a text. The empirical material was first coded from Watt Boolsen's (2007) seven principles. According to my purpose, I realised that

these principles were too brief and unclear when the large material needed to be reduced to what was emerging from the material. For that reason, Boyatzis' (1998) thematic analysis was found to be helpful.

Thematic analysis

Thematic analysis is understood as the process when the researcher encodes codes; the researcher encodes the information in the empirical material. That is why thematic analysis is a process for coming to an endpoint of interpreting results that can be considered as the themes that grow during this process. A theme is defined as "a pattern found in the information that at a minimum describes and organizes the possible observations and at a maximum interprets aspects of the phenomenon" (Boyatzis, 1998, p. 4). At the descriptive level, the theme can be identified from what is directly observable in the empirical material, or the latent level can highlight what underpins the phenomenon. The process of creating meaning from themes has been guided by thoughts on the empirical material from two purposes: *a way of seeing* and *a way of seeing as* (Boyatzis, 1998, p. 4, Boyatzis italics). However, a way of seeing focuses on how the researcher can find patterns in the empirical material. This purpose was guided through four steps that indicate themes at a descriptive level. In the first step, the raw information is reduced. The material is reduced through a process of reading and rereading the material. In this step, the aim is to understand and internalise the material. This process ends up with written outlines of text for each selection. In the second step, the material is interpreted further and a first draft of themes is developed for each selection of the material. In the third step, the preliminary themes are compared across the different selections. In the fourth step, the themes for the whole selection are created. The next level of thematic analysis takes its starting point from Boyatzis' expression of seeing as. Seeing as has a means abductive reasoning (Coffey & Atkinson, 1996). Thus, when the results are reported the themes are considered through a theoretical lens that makes the findings general in relation to the applied theory.

According to Boyatzis (1998), at least three major problems can be derived from thematic analysis: projection, sampling, and mood and style (Boyatzis, 1998, pp. 13-16). Projection highlights problems in the interpretation because the researcher is too familiar, ultimately making the interpretation normative, or that the interpretation says more of the researcher's feelings than what can be seen in the empirical material. Sampling highlights to what extent awareness gives the informants comfort and confidence in the empirical material. The fear of mood and style outline the situation of conducting thematic analysis, which can take time and highlights ambiguities.

Validity

The concept of validity has another meaning in qualitative research than in quantitative research. Qualitative research is associated with naturalistic inquiry that considers other criteria and includes the whole research process (Lincoln & Guba, 1985). In this research, the results from the three part-studies contributed to the validity of the meta-analysis in this thesis. Malterud (2009) argues about internal validity, which is about the relevance of concepts applied to and the relevance of the methods used in the research. In terms of the method applied to the analysis, an inductive approach is strongly related to the context of study since the code is derived from informants' words and meanings. With regard to the applied concepts for making the process of interpretation transparent, it is necessary that the theoretical assumptions that the analysis rest on are clearly expressed. For reaching the best validity as possible in the interpretations, rich descriptions of the context and the theoretical lens are provided. This approach creates greater conceptual coherence and meaning as a result of the integration of different sources (interviews, questionnaires, documents). For acknowledging the interpretations within a broader theoretical frame abductive reasoning is used.

Ethics

This thesis follows the ethical requirements outlined by the Swedish Research Council (2001). Based upon the ethical requirements, a statement of research ethics was agreed upon between teachers and students at the outset. The agreement addressed aspects of beneficence, non-malfeasance, informed consent, and confidentiality/anonymity. This agreement was distributed as a written document to the teachers. The students were informed both in text and orally during the first course meeting on campus. The personal information and code keys have been stored in a locked room at the department. The students were informed that they could interrupt their participation whenever they wished.

Theoretical framework

This section presents the theoretical framework that has been used for analysing the results. The first section presents a brief orientation of the theoretical framework that has been applied to the empirical material in each part-study for this thesis. The theoretical framework in the three part-studies focuses on both the local level and the institutional level of analysis with findings pointing towards a direction of change. As a result of that it was necessary to interpret the findings through a theory that explains change across different levels of analysis. The next section presents Bernstein's theory of the pedagogical device (Bernstein, 1990, 2000). The pedagogical device was found to be especially suitable because it can be used for conducting the analysis of change across the local and institutional level to a general analysis at the system level. The system level is considered as the shift in emphasis from teaching to learning in higher education.

Theoretical orientation

Table 7 presents an overview of the theoretical orientation in relation to the empirical material of the three part-studies.

Table 7. The theories used for analysis.

Part-study	Presented	Level of analysis	Theoretical and conceptual framework
I	Article I	Local level	Concepts of: Summative and formative assessment (Black & Wiliam, 1998a; Torrance & Pryor, 1998)
II	Article II	Local level	Transactional distance theory (Moore, 2007), learning theory (Illeris, 2009), theory for power and control (Bernstein, 2000)
	Article III	Local and institutional level	Theory for power and control (Bernstein, 2000), educational codes (Bernstein, 1990)
III	Article IV	Local and institutional level	Theory for power and control (Bernstein, 2000), educational codes (Bernstein, 1977)

In the first part-study at a local level of teacher education, the teacher-student relationship of process-based assessment was analysed through the concepts of summative and formative assessment (article I). The first part-study involved the moment of assessment, when teachers post feedback in relation to how students take in and think about the feedback. This part-study was helpful for raising questions about the social relationships in process-based assessment. The second and third part-studies focused on both the local and institutional levels. The research on the social relationships was based on the similar research questions with regard to: the teacher role, the student role, the learning process, and the assessment process in relation to traditional approaches to teaching, learning and assessment (articles II, III, IV). The theoretical journey has moved from cognitive theory of Moore (2007) and Illeris (2009) towards Bernstein's (Bernstein, 1977, 1990, 2000) system of thinking of social relationships and institutions. Thus, the theoretical journey has been eclectic, which probably can be related to a development of my own beliefs of the social relationships. However, at the local level of nurse education, the teacher-student relationships became visible by combining Moore's (2007) transactional distance theory with Illeris's (2009) learning theory. This theoretical framework was not enough for understanding the differences in the teacher-student relationship. For that reason, the teacher-student relationship was further analysed by using theory of symbolic power and control (Bernstein, 2000). Bernstein's theory of symbolic power and control is used to theorise the pedagogical communication and can be applied at both a local level as well as at an institutional level. For presenting the institutional level of nurse education and teacher education, the symbolic aspects of power and control were summarised in the educational code (article III, IV). The educational code demonstrates the social roles in relation to how teaching, learning and assessment are organised and conducted at the institution. In general, the three part-studies have demonstrated signs of how the pedagogical practice has particularly changed through the changed teacher-student relationship at both a local level and an institutional level. This indicated change was visible because of the shift in the relationship of power and control. For understanding this change further, the next section outlines the theoretical framework for the pedagogical communication at the system level.

The pedagogical device

Bernstein's (2000) theory of the pedagogical device is helpful for analysing the social practice in technology-rich learning environments, particularly by applying the recontextualising rule of the pedagogical device. Robertson (2006) uses the recontextualisation rule as a theorisation of the dynamics that shape teachers' practice when they integrate online learning

technologies to their practice. Similarly, Granberg (2011) uses the recontextualising rule for understanding the creation of ICT discourses in teacher education. In this thesis, Bernstein's (1990, 2000) theory of the pedagogical device is used to analyse the wider aim of the shift in emphasis from teaching to learning in higher education based upon the increased use of technology for teaching, learning and assessment. The pedagogical device is defined as a set of "ordering principles for the production, reproduction and change of pedagogic discourse" (Bernstein, 1990, p. 165). In the pedagogical device, Bernstein uses a rhetoric based upon relationships in contrast to dichotomies, giving a relative outcome of strong or weak. The reason to use the pedagogical device evolved from the findings in the empirical material of the three part-studies, which demonstrated a variation from strong to weak power relationships. In practice, change can be perceived as an arbitrary process, but in the theoretical perspective it is a process that is strongly regulated trough a set of rules: distributive rules and recontextualising rules.

Distributive rule

The distributive rule regulates who has the right to say what to whom and under what conditions, which highlights the symbolic power relationship between, for example, teachers and students. The distributive rule is used to demonstrate that the shift in emphasis from teaching to learning involves distribution of power in the pedagogical communication. When power is distributed, the distributive rule regulates all possible realisations. If the criterion of power distribution is reached it is then possible to analyse the pedagogical communication of teacher-centred teaching in relation to student-centred learning. Further, the power distribution creates a gap in which ideologies, here understood as beliefs, start to play. Bernstein explains that this is a matter of what is thinkable and unthinkable (Bernstein, 2000, pp. 28-29). The thinkable can highlight the current beliefs for traditional teaching and learning, for example through desk teaching and reproductive learning. In contrast, the unthinkable highlight beliefs that are tough to get at the current time of thinking, something imaginary, such as using technology for teaching, learning and assessment.

Recontextualising rule

The recontextualising rule becomes activated if the distribute rule outlines a shift in the power relationship. This rule is used to explain why there is a shift in emphasis from teaching to learning. The recontextualising rule is based upon relocation of discourse, that is verbally moving the discourse from its place of origin to a pedagogical place, for example when carpentry

becomes woodwork. The regulation in the recontextualising rule is here interpreted as a chain of sub-processes and sub-rules that create the particular pedagogical communication and practice in a higher education system based upon student-centred learning.
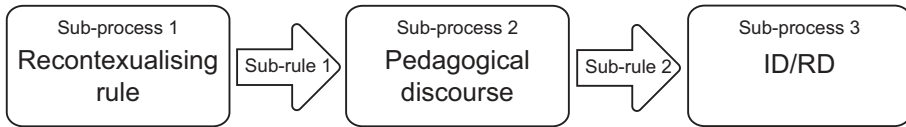

Figure 8. The chain of sub-processes and sub-rules.

Reading Figure 8 from the left to the right, the first sub-process of the recontextualising rule highlights the relationship between an actual and an imaginary discourse. It is this relationship that makes it possible to perceive "other discourses that constitute its own order and orderings" (Bernstein, 1990, p. 184). Thus, the first sub-rule outline is the relationship to other discourses, which makes the new discourse visible. Accordingly, the first sub-process is used to make the new discourse visible. In the second sub-process, Bernstein (1990) defines pedagogical discourse from the verbs "to choose" and "to create". The context and content from the new discourse creates and chooses a kind of pedagogical communication. The second sub-process is used to construct the pedagogical discourse in general. However, for analysing the empirical material in the three part-studies in relation to the pedagogical discourse, the third sub-process was necessary to use in the analysis. The second sub-rule says that the pedagogical discourse is embedded in two discourses: the instructional and regulative discourse (Bernstein, 1990). The instructional discourse (ID) highlights the daily pedagogical practice, while the regulative discourse (RD) focuses on values and rules of order. The pedagogical communication is always dependent on the regulative discourse since it is considered as the dominant discourse.

Results

The development of education considers aspects of both theory and practice. These were studied through the implementation of process-based assessment in the contexts of technology-rich learning environments in teacher education and nurse education. This investigation addresses the wider aim of creating a better understanding of the broader shift in emphasis from teaching to learning. The educational development considers the implications from both theory and practice perspectives for this purpose. The context of the study is based on the implementation of didactical designs for process-based assessment in three different technology-rich learning environments. The focus is on the social relationships in such contexts for teaching, learning and assessment. Three research questions were addressed:

- How do teachers and students understand process-based assessment for learning in technology-rich learning environments?;

- How can the teacher and student relationship be understood in process-based assessment for learning in technology-rich learning environments?; and

- How can issues of content be understood in process-based assessment for learning in technology-rich learning environments?

The sections below present the research results of each paper in this thesis by using a summary of theoretically and practically findings.

Research results of Paper 1

The first paper is entitled *Process diaries: Formative and Summative Assessment in e-learning* and was co-authored with Carina Granberg. In this paper, we developed the theoretical framework together and analysed one course each. This paper highlights the development of the design of process diaries during 2004-2005 in the context of teacher education, including both teachers and students. The paper builds upon two case studies of two distance courses about ICT and learning. The aim was to study if it was possible to combine the purposes of formative and summative assessment in the format of process-based assessment. For practice, the results outline the importance of timely feedback to students for supporting their development towards another approach to learning than what they were used to. Further, the analysis indicates that it was difficult for students to understand how

they should be assessed in process-based assessment. From a practice perspective the paper highlights two difficulties in particular. The first difficulty addresses the issue of combining the two purposes of formative and summative assessment. The second difficulty addresses the notion of creating meaning in reflective activities. In summary, the findings indicate how teachers and students understand process-based assessment and suggest the need for a third phase of reflection.

Research results of Paper 2

The second paper is entitled *Process-based assessment for professional learning in higher education: Perspectives on the student-teacher relationship*. The paper outlines a development of the didactical design into three phases of reflection applied in a context of specialist nurse distance education. The study aims to understand the teacher-student relationship from the students' point of view. The results outline issues for both theory and practice. The theoretical perspective outlines teachers' design of process-based assessment. The design affects the teacher-student relationship, which was analysed through Bernstein's (2000) theoretical framework of symbolic power and control. Theoretically, the analysis of the empirical material indicates a shift for teachers in terms of a weakening of symbolic power and control. Four issues emerged in the social relationships in relation to this shift in symbolic power and control, which have implications for practice. Firstly, students' reasoning was based upon confusion and previous experiences of how a course is framed in relation to the new experience of process-based assessment. Secondly, the teacher has a role to scaffold students' learning process by considering their wishes and demands in learning and to provide feedback with new and fresh insights. Thirdly, in the learning process students face new demands based on skills to identify and select content outside the formal course. In contrast, the learning process was strongly framed by the learning outcomes. Fourthly, the assessment process highlights students' awareness of diversity in content that does not support an assessment practice based on right or wrong answers. Moreover, teachers' didactical design of process-based assessment was not aligned to the course structure.

Research results of Paper 3

The third paper is entitled *Shifting the emphasis from teaching to learning: Process-based assessment in nurse education*. The study aims to understand the teacher-student relationship from the teachers' perspectives of process-based assessment in a nurse specialist distance education course. The design of process-based assessment is based upon a didactical design in three

phases. The design indicated three themes in the research: the teachers' relationship to the student; the students' interaction with the content; and the teachers' interaction with the content. The theoretical perspective outlines teachers' weakening symbolic power and control (Bernstein, 1977) in the teacher-student relationship. The weakening of the aspects of the social relationship highlights issues in relation to what can be regarded as educational content or not. This highlights perceptions of content as formal (valid) or informal (less valid), for example textbooks in contrast to students' reflections. In practice, teachers' teaching in process-based assessment was argued about as a problematising approach. The problematising approach focused on formal learning outcomes and revealed informal learning outcomes as "to make visual" and "to make aware of". Problematisation has implications for how students are supposed to act, for example through increasing responsibility by using the formal learning outcomes as pathfinders. Moreover, successful problematisation indicates a need for rich feedback to students. Assessment is understood as a relationship between teaching as problematising, and content as unknown and diverse. In practice, teachers' assessment outlines judgements that involve feedback on students' processes of creating meaning. Further, the symbolic power and control aspects highlight the role of the learning management systems (LMS). The LMS created limitations since the platform strongly supported forum discussions but the three stages of reflection in process-based assessment only to a limited extent. For practice this means that the social relationships that are anticipated being supported in the didactical design are not supported due to the inbuilt constraints in the design of the LMS.

Research results of Paper 4

The fourth article is entitled *Bridging the distance in teacher education: Teachers' perspective on process-based assessment*. The study aims to understand the teacher-student relationship by studying a group of teachers in a pre-school teacher education programme. The teachers worked in a project for educational development with the aim of bridging the distance between teachers and students in rural areas. Theoretically, the findings outline a shift of symbolic power and control (Bernstein, 1977) in the social relationships. For practice, the shift in symbolic power and control highlights three issues with regard to content, learning and teaching. Firstly, a diverse picture of the difficulties of changing emphasis from teaching to learning emerges. The difficulties are related to the symbolic power relationship raised from content with predefined learning outcomes in the syllabus in relation to informal student-generated content. Secondly, studying the student role in relation to content highlights a problem of superficiality. This problem is not merely a problem of students' writing. In student texts

teachers expect to find, for example, turning points in learning, which they seldom did. Since the content is not defined as such, the students' learning process becomes diverse. Thus, diversity in content weakens teachers' power and control in relation to who chooses the content. Thirdly, the online environment does not have a comparable status with the face-to-face environment, since the symbolic power relationship in terms of what can be considered as teaching or not is a matter for debate between the teachers. For some teachers, process-based assessment was based upon teaching as problematising students' learning in contrast to simply being precise in student answers.

Discussion of findings

This chapter provides a discussion of the results from the three part-studies with the aim of contributing to a better understanding of the shift in emphasis from teaching to learning from both theory and practice perspectives. Process-based assessment reveals four implications for understanding this shift. Firstly, the teacher role emphasises a process approach through facilitating students' creation of meaning. In the first perspective, the redefinition is based upon findings that highlight students' needs for negotiation, when informal content is used in the formal setting. Secondly, the student role involves a stronger sense of ownership that involves a redefinition of what can be addressed as educational content or not. This perspective is based upon students' skills in finding content, implications of an informal curriculum, and regulative aspects that are tacit and diverse. Thirdly, the learning process in process-based assessment considers aspects of lifelong learning by facilitating analysis of previous experiences longitudinally. Fourthly, the notion of assessment in relation to unknown content outlines new criteria for assessment with regard to the verbs "to make visual" and "to make aware of". The fourth perspective is derived from informal learning outcomes for process-based assessment. The four implications above are helpful for understanding the shift in emphasis from teaching to learning theoretically.

The social mechanism of symbolic power and control that emerged from the empirical findings is used as bases for understanding the shift in emphasis from teaching to learning theoretically. Bernstein's (2000) theory of the pedagogical device is applied through a series of analyses that outlines the relationships between teacher, student and content. The first section looks at the considerable overlap between teacher-content, student-content and teacher-student. The second section considers the multi-dimensional overlap between content-teacher-student. The third section outlines the research contributions, followed by a fourth section of the limitations of the study. The fifth section considers implications for practice.

The teacher-student-content relationship

The practice of process-based assessment highlights a teacher role of openness rather then authoritarianism. The student role involves issues of ownership and awareness. The issue of content involves the process of making informal content formal. Such practices indicate theoretically a shift in symbolic power and control from strong to weak. Based upon this, the theoretical understanding of the shift in emphasis from teaching to learning has led to an elaborated illustration about the content-teacher-student

relationship. This illustration aims to emphasise the weaker symbolic power and control relationships in the didactical triad by representing it in the Venn diagram with overlaps in the relationships between each aspects of the triad.
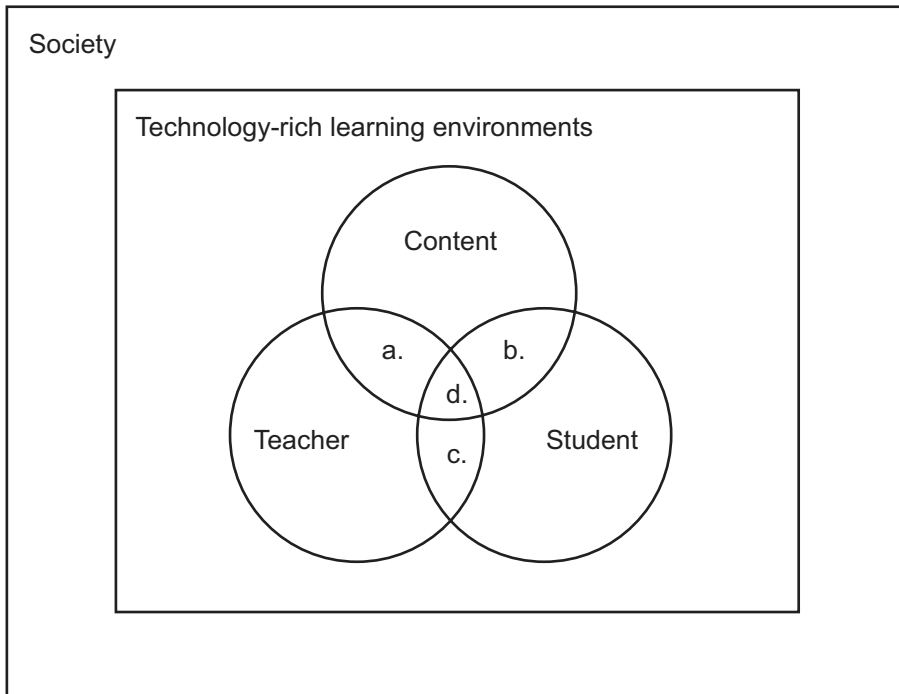
Figure 9. Content-teacher-student relationship in technology-rich learning environments.

This discussion of the empirical material in all three part-studies considers the relationships by focusing on the intersections of the three circles illustrated in Figure 9. Three aspects of interactions and connections emerged from the part-studies: teacher-content, student-content and teacher-student. The part-studies outline a shift of symbolic power, which transforms the level of interactions and connections to an analytical level of relationships between teacher-content, student-content and teacher-student. The shift of symbolic power illuminates the thinkable or the unthinkable (Bernstein, 2000) from the above findings. Further, such overlaps demonstrate how the context of process-based assessment for learning outlines what Bernstein (2000) considers as a gap or space between two discourses where beliefs play.

Teacher-content

The overlap in the *teacher-content* (a) relationship highlights beliefs from the teachers' point of view. The beliefs relate to informal content in which such content becomes educational content and also to questions about teaching in technology-rich learning environments. From the indicated shift in symbolic power and control, the unthinkable emerges through findings that demonstrate tacit conflicts with regard to teachers' beliefs of content in relation to teaching, or from confusion caused by the diversity in content. The thinkable emerges from findings that indicate that teachers demonstrate expectations of a precise and predefined content (Papers III, IV). In traditional teaching with the transmitter-receiver metaphor (Säljö, 2000), content is predefined and is not meant to be negotiated. Boud (1995) argues that such traditions outline assessment practices of the positivist tradition. Assessment in the positivist tradition measures to what extent students remember the content from teaching. However, the overlap indicates that the teacher has a relationship to the content that to some extent is unknown. The idea of the unknown is based upon the findings of informal learning outcomes in relation to the formal learning outcomes (Papers III, IV). Thus, the content depends on the teacher and vice versa. The overlap indicates the notion of a process in which teachers negotiate the content. Similarly, some teachers from teacher education (Paper IV) highlight diverse beliefs of the thinkable and the unthinkable through contexts for teaching. For teachers who considered the technology-rich learning environment as a context for teaching, this analysis indicates that the environment is difficult to separate from the content. Thus, the perspective of negotiating the environment adds an extra dimension to what can be considered as content or not.

Student-content

The overlap in the *student-content* (b) relationship outlines beliefs from students' perspective in relation to the shift in symbolic power and control. As outlined in the didactical design, the content of process-based assessment for learning includes students' reflections and experiences regarded as informal content. Black and Wiliam (2009) discuss teachers' and students' practice from the principle of catching "moments of contingency". The findings demonstrate a shift in the relationship of symbolic power and control that reveals the thinkable and unthinkable about content. Based upon Black and Wiliam's (2009) concept, process-based assessment highlights students' skills to use and catch moments of contingencies from their previous experiences and reflections. Similarly, Kjällander (2011) argues that informal content is increasingly used in technology-rich learning environments. Informal content relates to a process of transformation to

formal content, since the informal content considers students' personal storylines in relation to the learning outcomes of the course. The work of Klafki (2000) has already drawn attention to the fact that educational content has a relation to the student. This relationship brings a process dimension between the student and the content that involves explicit and implicit negotiation by the student about the unknown content (Paper II).

Teacher-student

In the overlap in the *teacher-student* (c) relationship, further aspects of the unthinkable emerge as a cause of the shift of symbolic power and control. These findings highlight a third aspect of negotiation and a shared process between teachers and students. The unthinkable in the student role emerges when students orchestrate and assess the learning process by questioning teachers' feedback. However, a tacit teacher-student relationship is outlined through unthinkable learning outcomes. Such learning outcomes were demonstrated in new competencies such as to show "awareness" and to make "visual" as new formal learning outcomes. The findings that indicate the role of the learning outcomes (Papers III, IV) corresponds with the findings of Lindberg et al. (2010) in relation to learning outcomes as a frame for creating meaning in students' learning. Thus, the separation between assessment and teaching becomes blurred when criteria are not merely a question for teachers but also act as pathfinders for students. The findings demonstrate the thinkable for students outlined in demands in the importance that students know how they will be assessed (Paper I). Torrance (2007) found that teachers' approaches to teaching were based upon "coaching for the criteria". Further, such practices involve rich explanations about the criteria decreasing the possibilities for negotiation. Other signs of the unthinkable emerged when the teacher role is transformed into the student role, when students chose their informal content (Papers II, III, IV) indicating a negotiation of the roles. Thus, in the teacher-student overlap the process aspect involves negotiation about the unthinkable in the use of criteria, and in the teacher role and the student role.

Content-teacher-student

The multi-dimensional overlap outlined in the *content-teacher-student* (d) relationship demonstrates how the shift of symbolic power and control outlines the very essence of the process. For understanding this multi-dimensional relationship, caused by the indicated shift in symbolic power and control, Bernstein's (2000) recontextualising rules are used.

Analysis of the pedagogical discourse

Thus, as illustrated in Figure 9, the overlaps expressed between two categories each—teacher-content, student-content and teacher-student—demonstrate a common emphasis on the process. This process outlines issues of negotiation within the overlaps. Without the demonstrated shift in power, the overlaps would not have been possible to consider with Bernstein's (2000) theory of the pedagogical device. Thus, from this analysis it emerges that together the categories create something more than what they contribute to individually. The next stage of this analysis will raise the level of analysis one level by focusing on process-based assessment through the multi-dimensional content-teacher-student relationship.

The further analysis of the multi-dimensional content-teacher-student relationship is based upon the shift of symbolic power. The shift of symbolic power makes the analysis of the findings appropriate for the application of Bernstein's (1990) recontextualisation rule. Principally, the recontextualising rule outlines what happens when a discourse is moved from one place to another (Bernstein, 2000). Since the findings highlight aspects of the regulative and instructional discourse, the chain of sub-processes and sub-rules were applied in reverse for analysing the pedagogical discourse. Accordingly, the recontextualising rule is modified as illustrated in Figure 10.
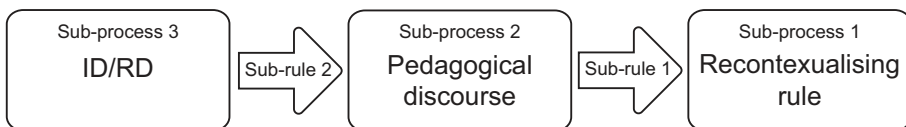
Figure 10. The chain of sub-processes and sub-rules.

As illustrated in Figure 10, the chain of sub-processes and sub-rules for the recontextualising rule are read backwards. The findings are considered as an interface for analysing what the shift of symbolic power and control further means. The next section starts with the regulative rules for process-based assessment. The second section looks at the instructional discourse, which is the process-based assessment practice. The third section analyses the pedagogical discourse for process-based assessment.

The rules of order for process-based assessment

The rules of order in process-based assessment are understood from the conceptual thinking of the regulative discourse. The rules of order highlight what can be tolerated or not in the multi-dimensional content-teacher-student relationship. The concept of the regulative discourse demonstrates how the context and content create and choose the order (Bernstein, 2000) for process-based assessment mediated through technologies. The context for this study is technology-rich, which means that communication, interaction and documentation are mediated through technology. Accordingly, teachers and students are forced to use technology for communication, interaction and documentation. At the time of this study, technologies such as LMS and a software application for documentation were used for this mediation. The inner environment (Simon, 1996) of these tools is part of the process that creates and chooses the particular order. Thus, in the process-based practice (outer environment) teachers and students are forced to this communication, interaction and documentation based upon the order technology affords.

Considering the issue of content in this study as a regulative rule, the process of making informal content formal is significant for process-based assessment. This defines the monitoring role for both teachers and students when using process-based assessment. Across nurse education and teacher education, the monitoring role for students involved increased responsibility for the selection of content, while teachers needed to design for the unknown in students' learning through meta-design principles (Fischer, 2007b). Thus, making informal content formal is one of the underpinning processes for the instructional discourse.

The process-based assessment practice

The previous section outlined the rules of order in process-based assessment that are based on the rules of order of making informal content formal in technology-rich learning environments. This section analyses the instructional discourse of process-based assessment outlined in the multi-dimensional content-teacher-student relationship. The concept of instructional discourse highlights how content and contexts choose and create the discourse itself (Bernstein, 2000). The instructional discourse outlines the process-based assessment practice from the empirical findings related to problematisation. Problematisation is understood as an approach that evolves from the possibilities for communication, interaction and documentation afforded by technologies.

The multi-dimensional relationship shown in Figure 9 illustrates that the different aspects of a pedagogical practice are kept together when power is distributed. Thus, it is difficult to separate teaching from assessment and criteria as a role for both teachers and students. Similarly, Torrance (2007) introduces the concept of "assessment as learning" that is a criteria-based practice in which teachers use assessment to coach students. The findings from the three part-studies demonstrate an approach to problematise. In relation to the teacher role, skills to problematise become crucial since the findings of this study demonstrate diversity in the students' content (Papers II, III, IV). Similarly, Russel et al. (2006) argue that the question of accepting diversity or not is the boundary between product and process thinking in assessment.

A problematising approach involves aspects of assessment since this approach does not separate teaching, learning and assessment. Thus, criteria are used in the approach but the question is what kind of criteria. The findings outline informal criteria as learning outcomes that demonstrate process outcomes through the verbs "to make aware of" and "to make visual". Such criteria can be further understood from Frånberg et al's. (2011) ideas of skills to create and recreate truth, meaning and reality. Content chosen for problematisation demonstrates another perspective of the process-based assessment practice. During problematisation, students need to demonstrate a process of students' creation of meaning between the informal content and the formal learning outcomes. In correspondence, Selander and Kress (2010) and Lindberg et al. (2010) discuss learning as a matter of creating meaning. The process of creating meaning is considered as an aspect of learning in the negotiation that is at the heart of a process-based assessment practice. The process of creating meaning is not purely individual, but it is also an issue of what kind of feedback the teacher submits in relation to the content.

The pedagogical discourse for process-based assessment

As illustrated in Figure 10, the second sub-rule of the recontextualising rule explains that the instructional discourse (ID) and the regulative discourse (RD) is embedded in the pedagogical discourse. The pedagogical discourse is a function of ID and RD, where RD is the dominant discourse. Thus, the emerging pedagogical discourse for process-based assessment can be summarised as in Table 7.

Table 7. The pedagogical discourse for process-based assessment.

Discourse	Rule	Process-based assessment
Instructional discourse		The pedagogical communication is based upon a problematising approach that keeps content, teacher and student together.
Regulative discourse	Content rule	Designs for the unknown. The process of negotiation of making informal content formal.
	Context rule	Technology-rich learning environment for communication, interaction and documentation.

The pedagogical discourse of a process-based assessment is based upon the multi-dimensional content-teacher-student relationship. The process-based assessment discourse exists because symbolic power is distributed. The pedagogical discourse of process-based assessment is regulated through designs for the unknown, the process of making informal content formal, and the pedagogical communication, interaction and documentation mediated through technology. Process-based assessment is based upon the problematising approach since the regulative rule has regulated such pedagogical communication.

However, the first sub-rule in the process of recontextualisation says that the pedagogical discourse becomes visible in relation to an already known discourse (see Figure 10). Thus, the pedagogical discourse that evolves from a multi-dimensional content-teacher-student relationship becomes visible in relation to the pedagogical discourse that is based upon strong symbolic power relationships between content, teacher and student. Considering the discourse is based upon strong symbolic power relationships, content is considered as objective and non-negotiable (Hudson, 2002). Such an approach to teaching and learning creates hierarchical relationships between teachers and students (Barr & Tagg, 1995; Säljö, 2000).

In summary, the pedagogical discourse for process-based assessment, as outlined in Table 7, has evolved from the local didactical design of process-based assessment. The policy expression of shifting the emphasis from teaching to learning that frames the practice is not a matter of abandoning teaching for learning (Carlgren, 2011; Niemi, 2009). The shift in emphasis from teaching to learning illustrates a discourse of the global and technology-rich society with new demands for the pedagogical practice. In

this thesis the discourse is considered as the imaginary discourse that is transformed to an actual discourse in practice (Bernstein, 2000). The imaginary discourse is based upon concepts of LifeLong Learning and learning to learn (The European Parliament and the Council of the European Union, 2006, p. 7). The pedagogical discourse of process-based assessment illustrates the actual discourse for the shift in emphasis from teaching to learning. The actual discourse highlights a practice based upon the multi-dimensional relationship between content-teacher-student evolving from weak symbolic power and control. The multi-dimensional relationship caused by weak symbolic power and control blurs the boundaries between teaching, learning and assessment. Accordingly, blurred boundaries highlight questions about who has the right to define teaching, learning and assessment.

Contributions

This section discusses the research contributions to this thesis. The aim of this thesis was to create a better understanding of the shift in emphasis from teaching to learning. This shift is considered as presented in Chapter 2 from perspectives of technology-rich learning environments, learning, teaching, and assessment. Such perspectives involve issues about the teacher role and the student role in the shift in emphasis from teaching to learning. The single most important piece for this thesis is the indicated shift in symbolic power and control.

Methodological contributions

The methodological approach for this thesis is based upon the well-established method of thematic analysis (Boyatzis, 1998) for interpreting qualitative data. The way of thinking with thematic analysis outlines interpretations at a descriptive level and interpretations through a theoretical lens. Theories are part of the methodology that creates the base for the knowledge development in which the empirical material is interpreted in relation to theories. Thus, there is an interplay between the methods and the theories that create the fresh insights for the study and how new insights are presented. The research approach of using theories has revealed things I was unable to see without theory, for example issues of the thinkable and unthinkable. Accordingly, other theories might have created other insights about this educational development. In the consideration of the research process, the framework of design-based research has supported the idea of aligning the individual part-studies. Thus, the design-based research approach for this thesis involves thematic analysis as a tool for making the social relationships visible in the enacted designs. To make sense

of the contributions, the next sections are separated into conceptual contributions, theoretical contributions and empirical contributions.

Conceptual contributions

At the outset of this study the concept of process-based assessment represented the educational development. During the period of the study, the analysis of the social relationships revealed how issues of teaching and learning have moved from the background to the foreground. Thus, the educational development has highlighted the multi-dimensional relationship contributing to a better conceptual understanding of the policy expression of shifting the emphasis from teaching to learning. Researchers (Carlgren, 2011; Niemi, 2009) have considered this shift as a reconceptualisation of teaching as a consequence of the reconceptualisation of learning and knowledge. The phrase "shifting the emphasis from teaching to learning" additionally involves issues of assessment and content. The increased use of technology—for example the use of social media applications—creates a frame in which students are producers of content. Similarly, the practice of formative e-Assessment highlights questions that blur how technical, social and pedagogical systems (Pachler et al., 2010) coexist.

Theoretical contributions

Theoretically, this thesis contributes to the field by using theory for symbolic power and control for understanding the shift in emphasis from teaching to learning. Bernstein's (2000) concepts for symbolic power and control have exposed the social mechanism for teachers' and students' social practice. The symbolic power and control relationships give points of reference for interpreting the relationships in the social practice of teaching, learning and assessment. The highlighted shift of symbolic power and control has been the platform for understanding didactical designs and the pedagogical discourse in the shift in emphasis from teaching to learning. This underpinning theory of symbolic power and control complements other similar approaches to didactical design based upon curriculum theory (Hudson, 2002) and multimodal theory (Selander & Kress, 2010). The shift in symbolic power and control highlights didactical design as multi-dimensional in technology-rich learning environments.

The pedagogical device (Bernstein, 2000) has contributed to an understanding of how the shift of symbolic power has changed practice. The changed practice is outlined through the concepts of the thinkable and the unthinkable (Bernstein, 2000). The notion of the thinkable and the unthinkable is helpful for answering the first research question of how teachers and students understand process-based assessment for learning.

The concepts have theoretically extended the understanding of the didactical framework for the content-teacher-student relationship. Further, in general the illustrations of the sub-rules and sub-processes that involve the recontextualising rule have contributed to interpreting a complex model for understanding change. In particular, Bernstein's (2000) theory of discourse creates a new framework for working with and interpreting pedagogical practice in which learning environments and content reveal the discourse. For this thesis, Bernstein's expression of discourse as "context and content create and choose" has been of major importance for understanding the multi-dimensional content-teacher-student relationship. This is also a contribution to understanding the roles of what frames a didactical design and practice. Accordingly, the symbolic power and control is significant for understanding the discourse in technology-rich learning environments.

Empirical contributions

This thesis contributes empirically to the field with knowledge about the process aspect in education. The empirical contribution highlights the shift in symbolic power and control. This shift is considered the mechanism that is changing the thinking about how to perceive the multi-dimensional content-teacher-student relationship. In the relationship between teacher-content, student-content and teacher-student, the meaning of the process concept for this environment was revealed. The process concept indicates a strong emphasis on negotiation. It is the intellectual activities of negotiation that indicate how the concept of process can be understood in this practice. Further, the individual parts of the process thinking—teacher-content, student-content, and teacher-student—together create a process discourse when perceiving them jointly in the multi-dimensional content-teacher-student relationship. The process rests upon three rules: designing for the unknown; making the informal content formal; and technology-rich learning environments for communication, interaction and documentation. These three rules outline the order in the pedagogical practice as teachers and students adapt to a problematising approach. In the problematising approach it is difficult to separate teaching and assessment. Both teachers and students intertwine teaching and assessment through problematising actions. Thus, the empirical contributions gather empirically grounded didactical designs for teachers that highlight the unknown, the concept of process as an issue of negotiation, and negotiation as a practice of problematisation for both teachers and students.

Limitations

The methodology outlined in this thesis involves a design-based research approach that was found to be suitable towards the end of this study. It is plausible to believe that the research design would have been different if this approach had been used from the first part-study. The didactical designs have both affordances and constraints. One affordance of the didactical design is the visualisation of the points of interaction and communication that enact the social relationships. The didactical designs have constraints with regard to limiting the possibility to reveal unknown issues in the social relationships. The study of the technology-rich learning environment could have been given more attention, which is probably a consequence of the decision to use interviews as the most important method for collecting data. The interviewees became the medium for understanding the technology-rich learning environments. However, the technologies studied in this thesis have had an impact on the didactical designs since the design is evaluated and designed with regard to technical affordances. With other technologies such as social media applications the design would probably have been different.

Implications for practice?

The theoretical insights contribute to a greater understanding of the shift in emphasis from teaching to learning, considering this shift needs to involve both content and context in the conceptualisation of teaching, learning and assessment. A possible model could be to consider the above analysis as a didactical design principle.
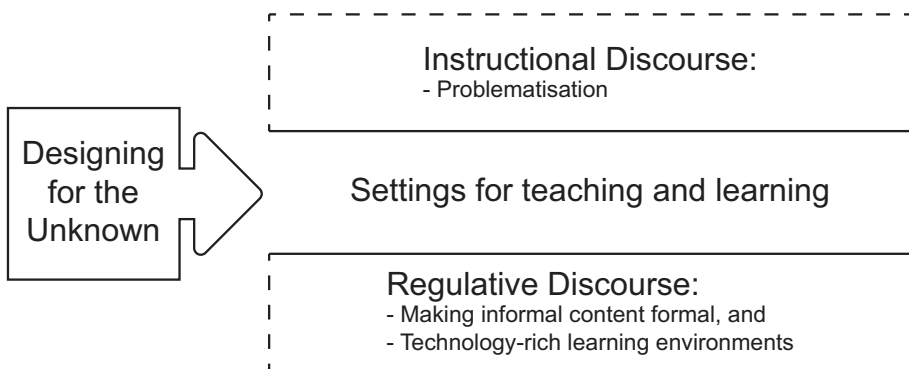

Figure 11. Designing for the unknown.

Figure 11 illustrates a practice that is based upon weak symbolic power and control for teachers. The notion of "designing for the unknown" highlights a framework for teachers' didactical design that allows student-centred learning through technology. Designing for the unknown frames settings for teaching and learning and means that the very nature of teaching and learning is based upon rules other than traditional teaching. Two discourses work in parallel and this forms both the teachers' and students' practice. Technology has developed since the part-studies of this thesis were conducted. Hence, personal learning environments such as mash-ups, for example MUPPLES (Wild et al., 2008) in which students combine different social media applications (Ebner et al., 2010) in learning such as blogs and photo sharing to something new. Such practice means that students choose different resources outside of the formal educational environment beyond the control of teachers. Accordingly, students' learning environments are unknown for teachers and this means that a reconceptualisation of teaching (Carlgren, 2011) must take place that involves greater trust in the student role. In other words, designing for the unknown embodies the shift in emphasis from teaching to learning.

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