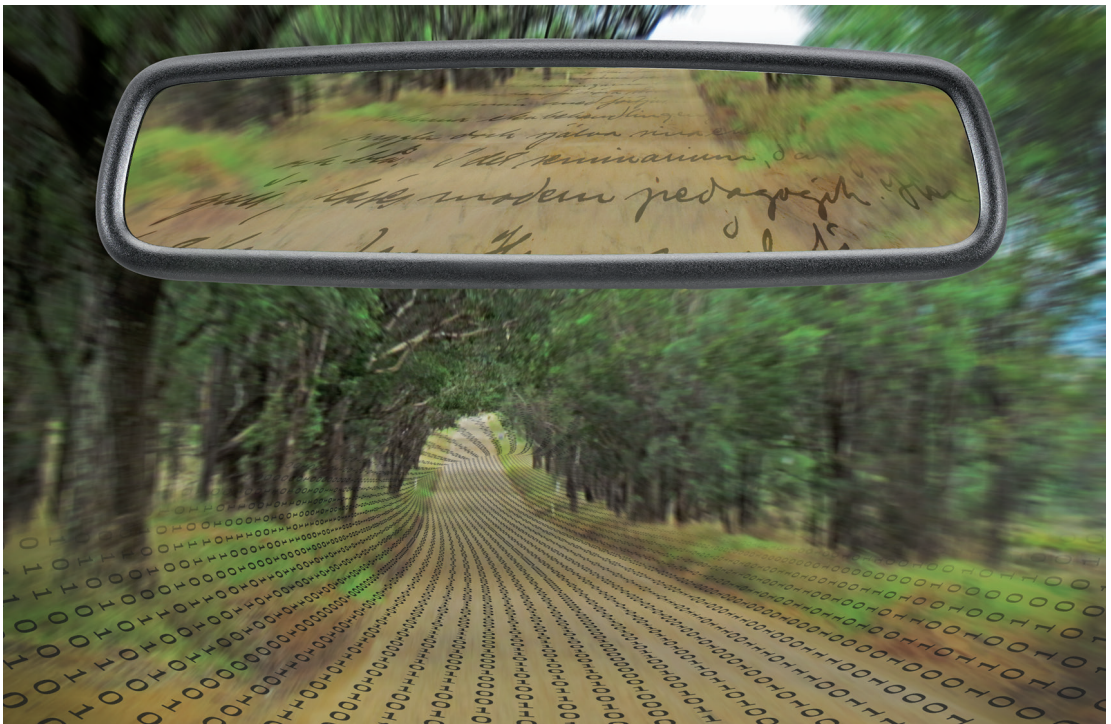Annika Wiklund-Engblom

Designing New Learning Experiences?

Exploring Corporate E-Learners' Self-Regulated Learning

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The cover image collage by Hasse Eriksson is illustrating Marshall McLuhan's citation on page 1. The collage includes an old text about distance education written by my late grandfather Erik Viljam Fågelbärj (1901–1961).

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Abstract

The context of this study is corporate e-learning, with an explicit focus on how digital learning design can facilitate self-regulated learning (SRL). The field of e-learning is growing rapidly. An increasing number of corporations use digital technology and e-learning for training their work force and customers. E-learning may offer economic benefits, as well as opportunities for interaction and communication that traditional teaching cannot provide. However, the evolving variety of digital learning contexts makes new demands on learners, requiring them to develop strategies to adapt and cope with novel learning tools. This study derives from the need to learn more about learning experiences in digital contexts in order to be able to design these properly for learning.

The research question targets *how the design of an e-learning course influences participants' self-regulated learning actions and intentions.* SRL involves learners' ability to exercise agency in their learning. Micro-level SRL processes were targeted by exploring behaviour, cognition, and affect/motivation in relation to the design of the digital context. Two iterations of an e-learning course were tested on two groups of participants (N=17). However, the exploration of SRL extends beyond the educational design research perspective of comparing the effects of the changes to the course designs. The study was conducted in a laboratory with each participant individually. Multiple types of data were collected. However, the results presented in this thesis are based on screen observations (including eye tracking) and video-stimulated recall interviews. These data were integrated in order to achieve a broad perspective on SRL.

The most essential change evident in the second course iteration was the addition of feedback during practice and the final test. Without feedback on actions there was an observable difference between those who were instruction-directed and those who were self-directed in manipulating the context and, thus, persisted whenever faced with problems. In the second course iteration, including the feedback, this kind of difference was not found. Feedback provided the tipping point for participants to regulate their learning by identifying their knowledge gaps and to explore the learning context in a targeted manner.

Furthermore, the course content was consistently seen from a pragmatic perspective, which influenced the participants' choice of actions, showing that real life relevance is an important need of corporate learners. This also relates to assessment and the consideration of its purpose in relation to participants' work situation. The rigidity of the multiple choice questions, focusing on the memorisation of details, influenced the participants to adapt to an approach for surface learning. It also caused frustration in cases where the participants' epistemic beliefs were incompatible with this kind of assessment style. Triggers of positive and negative emotions could be categorized into four levels: personal factors, instructional design of content, interface design of context,

and technical solution. In summary, the key design choices for creating a positive learning experience involve feedback, flexibility, functionality, fun, and freedom.

The design of the context impacts regulation of behaviour, cognition, as well as affect and motivation. The learners' awareness of these areas of regulation in relation to learning in a specific context is their ability for design-based epistemic metareflection. I describe this metareflection as knowing how to manipulate the context behaviourally for maximum learning, being metacognitively aware of one's learning process, and being aware of how emotions can be regulated to maintain volitional control of the learning situation. Attention needs to be paid to how the design of a digital learning context supports learners' metareflective development as digital learners. Every digital context has its own affordances and constraints, which influence the possibilities for micro-level SRL processes. Empowering learners in developing their ability for design-based epistemic metareflection is, therefore, essential for building their digital literacy in relation to these affordances and constraints.

It was evident that the implementation of e-learning in the workplace is not unproblematic and needs new ways of thinking about learning and how we create learning spaces. Digital contexts bring a new culture of learning that demands attitude change in how we value knowledge, measure it, define who owns it, and who creates it. Based on the results, I argue that digital solutions for corporate learning ought to be built as an integrated system that facilitates socio-cultural connectivism within the corporation. The focus needs to shift from designing static e-learning material to managing networks of social meaning negotiation as part of a holistic corporate learning ecology.

Preface

In 1998, my boyfriend, Kenneth Engblom, came home from work one day and told me that he had been offered a job in India. He said that he would agree to go only if I came with him. I hesitated a few seconds before stating my claims. I told him that I would accompany him if we got married first and if I would get my own computer and Internet connection wherever we were staying. Little did I know then that my second claim would forever change the way I viewed reality and the possibilities for communication and learning. And, of course, the first claim did change my life a great deal as well. While living in India, I changed direction from the field of developmental psychology to e-learning research. I started from zero – once again. However, I did not expect this research journey to span four continents and so much joy and sorrow, sickness and health. In many ways, I am a true distance student myself, having experienced all the challenges and also the privileges this entails. I strongly believe that we create our lives through the people we meet. These meetings give us opportunities to mirror our thoughts and learn about the perspectives of others, which shapes our understanding of the world, as well as our own identity in relation to it. There are several professors and researchers I have had the honour of meeting. Being invited into their discourse has impacted my research journey. I want to thank Sven-Erik Hansén, who has tirelessly helped me to see this work through and diligently guided me in my writing process, Göran Djupsund, who gave me a much appreciated place in his research school on media at a time when I was quite lost and lonely, Marc Hassenzahl, who gave me insights into design thinking and user experience research, as well as Rainer Nyberg, who inspired me to start this e-learning research. I also want to express my appreciation to Tom Wikman for reading my manuscript and giving me encouraging feedback, Mike Horsley for always boosting my self-esteem and giving me the opportunity take part in building the user experience laboratory at Central Queensland University, Peter Goodyear for allowing me to join in the CoCo seminars at the University of Sydney, Roger Azevedo for coming to our research methods symposium, Pat Bazeley for opening up her home at the research farm and teaching me about NVivo. I am also grateful for the valuable feedback I received from my reviewers Sanna Järvelä and Staffan Selander.

My dear colleagues at MediaCity have always believed in my ability and my effort, despite all the obstacles in my way. It has been a great joy and privilege to be part of this inspiring team. Thank you Kimmo Rautanen, Yvonne Backholm-Nyberg, Michaela Esch, Helena Johansson, Sören Andersson, Susanne Hägglund, Anette Bengs, Simon Staffans, Hasse Eriksson, Joachim Högväg, Joachim Majors, Anders Wik, Lasse Norrgård, Jonas Mastosalo, Mentor Dreshaj, and also Tommy Strandvall, who was my first tutor in MediaCity's lab. My collaborators of the Talking Tools research group have been a great inspiration to me, such as Juha Hartvik, Mia Porko-Hudd, Kasper Hiltunen, and Marléne Johansson. I am convinced that we will do great things together. Thank you Heidi Höglund and Charlotta Hilli for always being eager to network and collaborate in our transmedia learning design seminars and other educational media

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1 Introduction

"We drive into the future using only our rear view mirror."
Marshall McLuhan

This statement by McLuhan (1964) over half a century ago highlights the fact that new media – in any form – are something that we cannot adequately prepare for regarding their impact on our lives; we can only look back and see what has been. The title of this thesis similarly emphasises the fact that we do not know exactly how new learning technology will affect the way we learn. However, it will most certainly create new experiences for us as learners.

The context of this study is corporate e-learning at a multinational company. A computer-supported training course under development was tested on the target group in order to explore the group members' self-regulated learning (SRL) and how they developed strategies for successfully managing the learning context, as well as the course content. In the corporate world, much faith has been put into the success of e-learning, often driven by the belief that money can be saved when the work force can receive their training through e-learning, as it could take place anytime, anywhere, as long as there is a laptop nearby. Just upload the information online, and people will learn it. The potentially devastating effect of this belief is demonstrated in the following case of a corporate e-learner trying to learn:

> A male person in his 30s is sitting at a desk, staring into the screen of a laptop. The atmosphere is relaxed and quiet, except for a monotonous voice coming from the laptop speakers. The only noticeable movements visible to the eye of an observer are the person's right hand while moving the mouse, and the screen changing as the person interacts with something in the course. After a while, not even these movements are noticeable anymore. The person sitting at the desk has fallen asleep.

This is the scenario that unfolded during the pilot testing of a mass-produced corporate e-learning course in a media laboratory for user experience testing. It is an example of how digitalised material, framed as e-learning, can work against its own purpose to enhance learning. A sleeping mind is not a learning mind. The obvious questions are, of course, why did this person fall asleep, and what could have been done differently to prevent it from happening? How can we design educational technology to facilitate optimal learning? How can we design educational technology so that it supports learners in being and becoming self-regulated in their learning? I argue that the design of e-learning content needs to be anchored in human needs for learning, and also that the user experience of the learning context makes a difference for the outcome of the learning. Hence, both content and context are important building blocks of learning technology.

1.1   Background

In this study, I am investigating corporate e-learners, who are for the first time confronted with a new e-learning environment. This is a familiar scenario for most of us in contemporary workplaces; having to figure out how to manage new digital tools for various purposes. In the following, I argue for reasons why it is important to study this process of novice tech users, or, in this case, novice corporate e-learners.

We are all accustomed to traditional ways of classroom learning, where a teacher is the medium for providing us with information so that we can build knowledge, develop skills, and foster attitudes. Also, most of us know how to use a computer as a tool for our work and communication. However, when we combine these two scenarios, and place the classroom inside a computer screen, substituting the teacher with computer-based, automated instructions, technological tools and feedback, we can assume that the experience of learning becomes a new one (cf. Järvelä, 2010), especially since prior research has continuously shown that learning is dependent on and influenced by the context of learning (Bandura, 1986; Pintrich, 1989; 2000; 2005; Richardson, 2000; Zimmerman, 1989; 2005).

A technological tidal wave is flooding our society on all possible levels. The overall effects of this impact are yet to be seen. Schönberger (2006, p. 3) argues for three tendencies related to socio-cultural change from the use of ICT. The first argument is that ICT allows us to be more socially active, and participate and interact more intensely "within communicative social relationships". This, however, requires a certain level of media competence and digital literacy. The second argument highlights that ICT has invoked needs for new forms of trust building and rules of conduct. Also, new skills are required for making decisions or choices in digital environments compared to communication or learning situations in normal face-to-face conditions. The third argument emphasises how ICT has changed how we acquire, organise, store, and protect information. The added speed of intake, as well as the amount of information available result in increased options and choices for how we are able to access information and communicate.

Although humans have always used technological tools for survival, there has never before been such a tremendous development with regard to technology for nearly all areas of our lives. One could even say that today, in many respects, it is more about surviving the technology, rather than using it for our own survival. However, researchers like Andrews and Haythornthwaite (2007, p. 19) provide a positive perspective on humans and the evolution of learning technology. They believe that e-learning, even at its worst, will be continuously emergent and will change through users' demands, expectations, as well as through their idiosyncratic use and disuse. Despite a positive outlook on the adaptation of new learning technology, we cannot assume that the appropriation of new digital tools for learning is something that is innate to us. Research has shown that new generations, although being digital natives, do not necessarily know

how to successfully use digital tools for the purpose of learning (Goodyear & Ellis, 2010). More research is needed on e-learners' experiences and appropriation process (Davis & Wong, 2007; Azevedo & Aleven, 2013).

One main purpose of digital technology is to improve the quality of our lives by making tasks easier. However, the concern is that the development of technology is often driven by the innovations and the technology itself in focus rather than the needs of the end-users (cf. Norman, 1982). Tight budgets also limit options for target group testing. There often seems to be a discrepancy between what the actual product is supposed to deliver and how end-users are able to use it.

Additionally, we also want digital technology to bring about a positive user experience and engagement that motivates the end-users (Hassenzahl, 2010). The combination of both functionality, i.e. usability, and a positive user experience increases the possibilities of the aimed outcome being achieved (Stewart, 2008). In the case of educational technology, where the purpose of the technological solution is learning, I argue that a positive user experience is just as important as functionality.

For the design and development of learning technology, we need the tight cooperation of both learning scientists and engineers of human-computer interaction (HCI). From the perspective of learning sciences, the purpose is to facilitate learners in constructing understanding of the content (Reigeluth, 1999). However, Siemens (2010) opens up for a broader educational perspective, as he points out that how we design and use technology is ultimately about philosophy and ideology. "To change education is to change society" and how software tools are being used for learning is a way of renegotiating the way our society functions (ibid, 2010).

The HCI-perspective has historically been focused on the technological context and how this can be adapted to the physiological and psychological limitations of our bodies and minds (Stewart, 2008). The difference between the perspectives is also seen in the terminology describing the end-user of a product: from an educational design perspective he/she is a learner in a learning environment (e.g., McKenney & Reeves, 2012), from the perspective of HCI design he/she is an interactive user of a system (Dix, Finlay, Abowd & Beale, 1997), and from an experience design perspective he/she is a motivationally directed user responding emotionally to a product triggered by fundamental human needs (Hassenzahl, 2010).

The corporate e-learning revolution did not happen as quickly as was foreseen. The reason for this might be that information and communication technology (ICT) is still mainly used as an information delivery tool, and not regarded as a possibility for shaping a new paradigm for learning and training (Carneiro, 2005). This seems not to be the way to use it to its full potential, and it is probably not serving learners' needs either. Carneiro (2005, p. 15) concludes his introduction on self-regulated learning in technology enhanced learning environments with a view from industry that:

> A practical conclusion [..] is that industry is bound to organise some form of "managed" self-regulated learning as an integral part of everyday work. Companies need to tap into the creative power of their workers in order to cope with ever-changing work and business processes.

In order to succeed with the effort of creating this new paradigm of corporate e-learning that Carneiro is emphasising, we need to know more about corporate learners' learning – especially how and why they make choices for learning when they are faced with a new e-learning environment. From this perspective the phenomenon is theoretically framed within the field of educational psychology. From the HCI-perspective, that is, the design of the context, it is equally important to know whom one is designing for, as well as what one is designing for. Knowing the target group is an important key to successful design, development, and implementation in HCI, as is the goal of a design (Dix, et al., 1997), which in this case is learning.

In the present study, the target group is represented by adults working in the corporate sector. Malcolm Knowles, one of the first to explore the learning of adults, claims that adults prefer hands-on experiences and problem-solving approaches, and also that they expect to apply new knowledge and skills immediately, in order to aid retention (Knowles, Holton & Swanson, 1998). Adults are pragmatic learners and motivated by the opportunity to improve their work skills (Conlan, Grabowski & Smith, 2003). Intrinsic motivators are more valuable than extrinsic motivators. They further want to know why they are learning something, and they want to see a personal benefit from it (Knowles et al, 1998). Their learning is aimed at integrating new information with their prior knowledge (Brookfield, 1996). Therefore, adults' prior work- and lifetime experiences need to be taken into consideration, as well as their involvement and self-direction in choosing their own paths in learning (Knowles et al, 1998).

These research findings show the importance of the relation the adult learner associates with the work context and his/her own situation in it. Content needs to be targeting the business challenges of the organization, i.e. the context (Bersin, 2004). However, we also need to ask whether there is more to adult learning in the context of self-paced e-learning. The word self-paced implies that the learner is on his/her own and independent in the learning environment. Being independent requires both self-direction (knowing where one needs to go to attain a particular goal) and self-regulation (knowing how to cognitively and emotionally regulate oneself and the environment in order to reach one's goal with the skills one has).

E-learning has been found often to be lacking in supporting learners' self-regulated learning needs (LeFrere, 2005). This is perhaps one reason why problems of learner perseverance in e-learning courses are a common issue (Davis & Wong, 2007), and why corporate e-learning has not been as successful as was initially expected (Carneiro, 2005). To counteract this, we need to learn more about the e-learning end-users' experiences and also identify e-learning solutions that are suitable to the learning needs of e-learners (Davis & Wong, 2007). This is the background framing the present study:

the reciprocal adaptation between corporate e-learners' learning needs and the design of learning technology. How are corporate e-learners unique in their needs for learning, and how can we design environments that support their SRL?

1.2   Motives

There are several motives that led me to study the field of e-learning, both professional and personal. These concern the societal change emanating from the impact of technology, the lack of e-learning design expertise and knowledge, a methods exploration related to user experience (UX) and self-regulated learning (SRL), and finally, an innate interest in using and mastering technology, especially for the purpose of learning.

My first motive is related to the technological change we are experiencing in our society today and the impact it has on our learning. There is no doubt that the technological evolution is changing our learning contexts. One result of this is that digital competence is nowadays seen as a required skill for students (Kjällander, 2011). Half a century ago, McLuhan (1964) said that the tools we shape and use will shape us in new ways. My understanding of his statement in the context of e-learning is that we are continuously learning to learn in new ways, while we are subjected to new learning tools. Digital technology is seen as new mediating tools for learning, which will then shape us, as well as our culture (cf. Kress, 2010; Säljö, 2000). However, more research is needed to explore this continuous contextual change and the impact it has on our learning (Davis & Wong, 2007; Azevedo & Aleven, 2013). What kinds of philosophies and ideologies do we want to be the directing principles of how we design learning technology, and by them change our society and how people learn (cf. Siemens, 2010)?

Prior research has been consistent in highlighting that context affects our learning (Bandura, 1986; Pintrich, 2005; Zimmerman, 2005; Weinstein, Husman & Dierking, 2005). As the context of e-learning is different from a traditional study environment, we can assume that the learner to some extent must be flexible and adapt his/her ways of learning to new contextual demands (Dettori, 2013). Therefore, in this study, it is assumed that in a self-paced e-learning course, SRL might take a different form compared to traditional learning situations, due to the changes of the situational variables (cf. Bandura, 1986; 1997; Azevedo, 2007; DiPaolo, 2001; Järvelä, Hurme & Järvenoja, 2011; Susimetsä, 2006; Tsai, 2009). Designing learning technology should not be based on theories from a traditional learning context (Kjällander, 2011; Kress, 2010; Kroksmark, 2011; Tsai, 2009). With regard to this standpoint, we need to learn more about SRL in the context of corporate e-learning.

My second motive relates to the practical side of designing and developing corporate e-learning. Peters (2013, p. vi) highlights the problem in the preface to her book, Interface Design for Learning:

> For a decade now I've been marvelling at the fact that, despite the eLearning explosion across industry and education, the thousands of designers responsible for creating these learning environments face a conspicuous lack of help. Of course, we thrive on the wealth of knowledge available from user experience and web design, but learning really is unique, and design for learning requires specialized knowledge.

During my search for potential corporations to collaborate with in my research, I became involved in several projects for e-learning development. The reason was that there was a lack of IT-pedagogy expertise in the corporate world, as the field was in its infancy – at least in Finland. However, there was little interest in involvement in research on the corporate side. This situation led me to become involved in design teams at three multinational companies for developing corporate e-learning material, which gave me insight into the world of corporate e-learning design and development from a grass roots perspective. The fact that corporate e-learning had a rough start during the beginning of the 21st century (Carneiro, 2005) is perhaps related to this lack of educational expertise in the field. Furthermore, there has been little research done on SRL of corporate e-learners, as most SRL studies are conducted in primary school settings or higher education.

Since 2008, I have been employed as research coordinator at MediaCity, a research and development unit at Åbo Akademi University. At MediaCity our research is focused on user experience studies as a support for iterative development of digital media solutions. We are also involved in the design and development of learning technology using a user-centred design approach. While working collaboratively with the creative media industry, we see over and over again how the iterative approach to the design phase is compromised and products are pushed out on the market without being properly tested for usability and user experience. There still seems to be much work to be done in propagating the human side of Human Computer Interaction (HCI) design and development.

My third motive relates to an exploration of methods for the purpose of learning more about mixed methods. One key factor that has had a big impact on this study was the development of a user experience laboratory in 2003 at MediaCity. Since the lab was new, the methods used there were in a trial phase. For this research study, multiple methods were tried in order to see what kinds of data would be generated, what kinds of angles could be explored concerning my research question, and how different methods could allow for a varied exploration within this particular context of study.

My fourth and last motive is personal. Why we choose what we choose in life is also one kind of self-regulation, although on a higher level than the focus of this thesis. I have always been interested in technology, and while living for a few years in India, I experienced first-hand the potential it could have for communicating and learning. As the saying goes in India, when the timing is right the teacher appears. Soon enough, I came across Professor Rainer Nyberg, who was heading an ICT-project at the Faculty of Education at Åbo Akademi University. I became interested in his project and decided to

endeavour to study the field of e-learning. A two year IT-pedagogy distance education at Kalmar University (2001-2003) gave me a more solid ground to stand on, as I came from the field of developmental psychology, having education as a second major only. However, the psychological perspective is still one of my core interests, but applied in the context of self-paced e-learning. Thus, the scientific perspective is that of educational psychology in the design of e-learning solutions.

1.3 Aim

This study targets how corporate e-learners manage a self-paced e-learning course. How learners adapt their learning and develop successful learning skills is studied as self-regulated learning (SRL) within the field of educational psychology (Boekaerts, Pintrich & Zeidner, 2005). There is a need to expand the understanding of SRL of e-learners in the corporate context, as research on SRL in this area is rather scarce. The aim of the study is to understand more about the dynamics of SRL by exploring the e-learning experience of corporate e-learners from a broad perspective. The pursued outcome, as an extension of the aim, is to learn how we can design e-learning solutions that support and facilitate SRL.

I also see this kind of research as important for the design of HCI systems in general, where we need to learn how to use a digital interface in order to carry out tasks. As mentioned earlier, the design of HCI-systems have to a large extent been focused on our bodily and cognitive limitations, as well as mainly targeting the functionality and performance of tasks. This study aims to give a broader understanding of how we learn to manage the e-learning context with regard to all factors that influence us in how we make choices for our action, and hence, how we are self-regulated learners. The end-users of HCI systems are more complex than what merely our cognition allows us to be. Furthermore, this study will hopefully highlight the importance of educational experts to be involved in the design and development of corporate e-learning (cf. Peters, 2013), and that the studied group of corporate e-learners have unique needs in relation to their position in the corporate world.

1.4 Positioning the study

The empirical study is embedded in an iterative design process of the e-learning course subjected to study. Researching such a design process, with the dual ambition of both course improvement through iterations of development, and a theoretical contribution to learning sciences, can be described as educational design research (McKenney & Reeves, 2012). As stated in the aim above, the theoretical focus lies on the participants' SRL, which is referred to as their ability to exercise agency over their learning process in various ways (cf. Azevedo & Aleven, 2013).

The figure below illustrates how the scientific field of self-regulated learning (SRL) intersects with the design of learning technology, and educational design research. These

are the three pillars supporting this research study. The centre piece of the triadic intersection represents the area to which this thesis aims to bring added value; that is, understanding more about e-learners' SRL, and how to design for it. Hence, there is a design perspective relating to the design of learning technology. This study is, furthermore, framed as educational design research, as it explores the participants' actions for learning in relation to two iterations of a learning design (McKenney & Reeves, 2012). This will be discussed more thoroughly in the chapter on methods and case description.
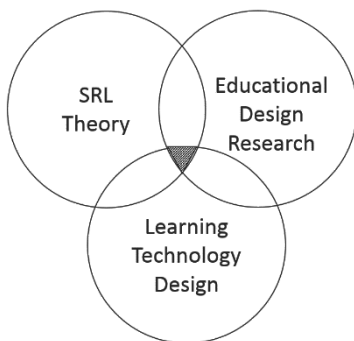
Figure 1   Intersections of the scientific fields of the present research study.

Educational design research is usually carried out as large studies involving several iterations of learning designs and complex collaboration of contributors over a long time period. This ensures the validity of its contribution to theory. A small study, such as the present one, cannot aim for significant contributions to theory (hence the small intersection in the figure above). Nonetheless, it still aims for deepening the understanding of SRL in the context of corporate e-learning, and how this understanding can be used pragmatically for designing user-friendly learning technology. In order to position the study theoretically, these three perspectives will be described and discussed thoroughly in the next chapters.

1.5   Structure of the thesis

Chapter 1 is a short introduction to the chosen subject, by presenting the background arguing for the importance of this study, the motives behind my choices, and the aim of the empirical investigation. Furthermore, the study is positioned at the intersection between the field of educational design research, learning technology design, and self-regulated learning.

Chapter 2 presents learning technology from the design perspective. I discuss how learning technology design is historically influenced by different learning paradigms. It is also a brief walk into the concepts and design thinking of learning technology and e-learning research.

Chapter 3 shortly explains educational design research as a genre used for learning technology design. It describes how the development of learning designs is iterative, and the research feeds back to improve the next iteration. The chapter highlights how this study is framed within this research genre and aims to contribute to both theory development and the iterative design of one specific e-learning course.

Chapter 4 looks in the rear view mirror of theories of self-regulated learning (SRL). The chapter casts light on the various factors that are involved in the process of SRL. Special attention is given to studies on SRL in contexts where learning technology is implemented for adult learners. The question that surfaces is whether, or how, SRL theories from traditional learning contexts are applicable for properly informing designs for learning in new technology-enhanced environments in the workplace.

Chapter 5 lists the main research question, which emanates from the theoretical background. More specific questions are used for framing SRL as broadly and openly as possible. The purpose is to be open enough to be able to detect new dimensions of SRL within the context of learning technology, and in the specific context of corporate e-learning. The questions illuminate the perspectives I have chosen to guide the research analysis.

Chapter 6 describes the research design, methods, data collection, and principles of analysis. However, firstly, I scrutinize methods used traditionally for researching SRL, and use this as a base for discussing the choice of methods in the study. The mixed methods research process calls for iterative steps of analysis of the multiple types of data. This process is described with regard to the principles of analysis used and the differing perspectives that are provided in the exploration of SRL.

Chapter 7 is a case description illustrating the two iterations of the selected e-learning course, including phases of development and how these relate to educational design research. Changes made to the course based on the feedback on the first course iteration are highlighted. Finally, I provide two narratives of two participants' learning sessions, which are displayed next to meaning condensations of interviews, in order to give an idea of the data comparison process, and also the dynamics of the learning process studied.

Chapter 8 is structured in accordance with the posed research questions. The results are presented with in-depth descriptions of how the data and analysis have provided answers to each question. Excerpts are used for illuminating the results. Prior research is, furthermore, discussed in relation to the results.

Chapter 9, the discussion of the results of the study, involves a thorough examination of how the study answered the research questions, and how this relates to prior theories of SRL. The focus lies on describing the participants' SRL and how this is facilitated or not by the design of the course.

Chapter 10, the conclusions drawn from the study, is a critical exploration of the possible implications of the results for corporate learning. Conclusions are drawn based on how the results can be of use for designing learning technology that facilitates and supports corporate e-learners' self-regulated learning. Three dimensions are highlighted in relation to whether we are designing new learning experiences in the digital landscape. Finally, ideas for future research is suggested, as well as methodological considerations of the present research design.

2   Learning technology design

Learning technology design is one of the three pillars (as illustrated in Figure 1), on which this research investigation stands. It represents the context subjected to study. This chapter gives a brief overview of how terminology is used to describe this specific learning context, as well as the paradigms that have impacted on the development of learning technologies throughout history. The other two pillars of this thesis (educational design research and self-regulated learning), displayed in Figure 1, are scrutinized in the next two chapters.

2.1   Overview and terminology

Learning technology is a broad term signifying technological tools for the purpose of learning (Azevedo & Aleven, 2013). The term e-learning, is also commonly used when discussing the use of computer-based technological tools for learning. However, in this work, e-learning refers both to the tool and the verb pertaining to the learning process, whereas learning technology only pertains to the tools used for learning. There are several similar terms synonymous with e-learning, such as online learning, digital learning, web-based learning, technology enhanced learning, and computer supported learning. For simplicity, I have chosen to use the term e-learning, as it is a broad term that can include learning in any kind of digital environment. Nonetheless, I will be using synonyms occasionally, for instance, for the purpose of defining differences in perspectives. E-learning constitutes different forms of delivery of learning facilities compared to traditional learning. Therefore, defining e-learning is about discussing the methods of delivery, and also instructional methods. E-learning is defined by Clark and Mayer (2002, p. 13) as:

> [..] instruction delivered on a computer by way of CD-ROM, Internet or intranet with the following features: includes content relevant to the learning objective; uses instructional methods such as examples and practice to help learning; uses media elements such as words and pictures to deliver the content and methods; builds new knowledge and skills linked to individual learning goals or to improved organizational performance.

This definition concerns the what, how, and why of e-learning, involving blended and multimodal content delivered with a mix of technological tools. Today, however, we might also be referring to a mobile phone or other mobile devices whenever it is used in the same way as a computer for the purpose of learning. Another definition of e-learning by Andrews and Haythornthwaite (2007) emphasises more the co-evolutionary view in which the focus is on a social and emergent nature of e-learning.

> E-learning is continuously emergent, emanating from the possibilities of ICT in the hands of administrators, instructors, and learners, and created and recreated by use. The forms and shapes of technology, learning, and technology-in-use for learning co-evolve, one pushing, pulling, and modifying the other. (ibid, p. 19)

Their definition has a strong social emphasis, and they further state that stand-alone learning programmes, such as self-paced tutorials (as the selected course in this study resembles) are peripheral to what e-learning is all about, although these can also be successful for learning purposes. Clark and Mayer (2002) discuss the elements that make e-learning unique when it comes to instructional methods, which might make it a potentially valuable form of learning technology: "1) practice with automated tailored feedback, 2) integration of collaboration with self-study, and 3) use of simulation to accelerate expertise" (ibid, 2002, p. 13). Synchronicity or asynchronicity are other characteristics of e-learning, describing aspects of the methods of delivery. These terms refer to the time of study in relation to other participants or teachers/trainers. Synchronous e-learning allows people to work together at the same time, although they are in geographically different places. Asynchronous e-learning allows people to choose both time and place according to their own needs (Yost, 2007).

In this thesis, the word self-paced refers to individual delivery of learning content where the learner works independently on a piece of material (learner-content interaction) and there is an absence of a teacher/trainer. The design of the content and the learning environment are the mediator and facilitator for independent learning. From the learner's perspective, self-paced e-learning may provide benefits, as it usually is neither linked to a specific time and space, nor pace. Self-paced e-learning is common in corporate learning, where companies want e-learning to be designed in a way so that they can save money on trainers, travel and time. Live e-learning is commonly referred to as synchronous learning where other learners and teachers are available during the time of study; their work is synchronised with that of the students (Yost, 2007). The present research study targets the development of a specific course for self-paced e-learning in a corporate setting. Hence, I will not be discussing live, or synchronous e-learning solutions.

The text above briefly highlights different characteristics of e-learning, when referring to it as learning technology: the tools and methods of delivery. Mor (2011, p. 1) writes in the abstract to his dissertation: "The characterisation of education as designed learning establishes a multi-faceted link between design and epistemology, or the creation of knowledge". Selander (2008) identifies three building blocks: material, temporal conditions, and learning activities. How we choose to arrange these constitute the conditions we create for learning, which is also referred to as designs for learning (Kjällander, 2011; Selander & Kress, 2010) or educational/instructional design (Ertmer, Parisio & Wardak, 2013). Furthermore, the term design in the context of learning can signify both the process and the product (ibid, 2013).

In this thesis, I use the term learning technology design as a concept that includes both the design of the technology (e-learning environment/context) and the design of the content (the material to be learned). Although, in a practical sense, the technology is the mediator and the content is the mediated, I explore it from the learner's perspective, where the lines between the two are blurred. This is advocated, as designers of learning

technology are encouraged to make the technology as transparent as possible (Burge, 2001). Furthermore, I use the term e-learning solution to describe technology-based learning solutions, such as courses, platforms, or other technologically enhanced systems that are aimed for use in learning. E-learning as a term is often used as a verb to describe the activity of learning whenever technological tools are involved to aid the learning process.

2.2   Impact of learning paradigms

The conceptions and understanding of what learning is, will become implicit in the designs we create for learning (Duffy & Jonassen, 1992). A consequence of this fact is that the design of learning technology has evolved at the same rate as the theoretical paradigms for learning have changed. Although these paradigms have represented worldviews on a larger scale, in the following, I will only give a brief overview of how the paradigms of learning theory have impacted learning technology and its design.

During the last century, the design of learning technology has been influenced by the theoretical paradigms and development of learning theories such as behaviourism, cognitivism, constructivism, and socio-cultural theory. Theoretical views on learning have shifted from focusing on behaviour and responses to our thinking, our construction of meaning, to centre on the individual situated within a social context (Illeris, 2007; Säljö, 2002; Järvelä, 2001). Finally, today, learning is seen as a larger dynamic process outside the individual based on affordances of connectedness of the digital landscape (Siemens, 2005). Likewise, theories influencing learning technology have shifted from emphasising the learner's external performance, to focusing on the internal processing of the learner, to finally focusing on the learner's communication, collaboration and use of skills in a specific social and cultural setting (Goodyear & Ellis, 2010; Kjällander, 2011; Tennyson, 2010).

Focus on behaviour

The evolution of learning technology began at the beginning of the twentieth century with a physicalist approach, where the non-verbal roles of audio-visual materials and devices and machines were used. No focus was aimed at the learner and his/her process of learning. Behaviourism came into the picture in the 1950s (Tessmer & Jonassen, 1988). Massive recruiting during World War II gave rise to programmed instruction. This explains the militaristic approach to instruction at this point in time (Jonassen & Land, 2000). A behaviouristic approach to instruction was applied, which included small instructive steps alternating with constant corrective feedback to the learner on his/her performance. According to behaviourists, we learn to respond to a stimulus through reinforcement of our actions. Thus, the role of a teacher is to provide reinforcement, interaction and feedback in a learning situation. The change in our responses is seen as learning, and through measuring behaviour we can measure learning. In behaviouristic curriculum design, task analysis and objectives are emphasised (Tennyson, 2010).

Focus on cognition

Neo-behaviourists acknowledged the cognitive aspect of the learning process, but did not define it further. However, the learning process was now considered in designing learning technology. This can be seen in the use of terminology for technology-enhanced learning. The term *Computer Aided Instruction* refers to a behaviouristic use of learning technology, while the term *Intelligent Tutoring Systems* is based on a cognitivistic approach to instruction (Lilja & Lindström, 2002).

The cognitivistic view of learning developed from research in educational psychology and cognitive variables affecting learning. The cognitivists saw learning as something active and organismic where learners were actively participating in constructing and building knowledge, contradicting the behaviouristic view, which saw learning as being a simple, reflexive, and quantifiable act. The cognitive model emphasises the learner's organisation, processing and storage of information, based on the theory that we organize our knowledge in schemas or networks, and this was to be considered in the design of learning technology. Also, the prior knowledge of a learner is acknowledged as an important aspect. Learning strategies developed as a part of the cognitive revolution (Tessmer & Jonassen, 1988). They are utilized by the learner to control comprehension and information management, and also to integrate new learning and reorganise their cognitive structures accordingly. Cognitivists see the aim of instructional technology as designed to activate appropriate learning strategies in the learner (Tennyson, 2010).

Focus on construction

Constructivism is based on a combination of research within cognitive psychology and social psychology. The verb to construct is derived from the Latin *con struere*, which translates into arrange or give structure. In line with the linguistic heritage, constructivism is conceptually referring to the ongoing cognitive structuring (organising) processes. Tennyson (2010, p. 7) explains it like this: "The constructivist view of learning positions is that an active, self-regulated, goal-directed, and reflective learner constructs personal knowledge through discovery and exploration in a responsive learning environment".

There are many branches of theories within constructivism. The Society for Constructivism in the Human Sciences (founded in 1996) defines human beings as "actively complex, socially-embedded, and developmentally dynamic self-organizing systems" (Mahoney, 2004). According to theories of constructivism, knowledge is not a fixed object, but rather a construct individual to each person, in which comprehension is created through construction of meaning. The learner must actively construct his/her own knowledge and skills (Bruner, 1990), and therefore, cognition is situation-bound and distributed (Brown, Collins & Duguid, 1989). Objects of learning are never separately integrated into our minds, but built into schemas of prior knowledge

structures. Thus, constructivism sees the learner as the knowledge builder where his/her prior knowledge and experiences play a significant role for the cognitive construction process, and should therefore be the focus of instruction.

In constructivist learning environments the role of the teachers is to act as facilitators. Their task is to allow students to formulate their own method of learning. In his book *Toward a Theory of Instruction,* Bruner (1966/1974) addresses four major aspects significant to a theory of instruction: 1) a learners predisposition towards learning, 2) how to best structure the content in an easily digested form, 3) structuring content sequences based on the most effective order, and 4) defining the best levels of rewards and punishment. Jonassen, Dyer, Peters, Robinson, Harvey, King, and Loughner (1997, p. 127) name a few contemporary hypertext-based instructional design models that are influenced by constructivist epistemology. These are anchored instruction, cognitive flexibility theory, goal-based scenarios, and case-based learning environments. The factors that these instructional models have in common are that they are based on authentic contexts, they promote self-directed learning, and facilitate cooperation and collaboration among students and instructors. They further propose learning activities that encourage a high level of thinking and the integration of new information with prior knowledge structures, so that the number of access points to stored information is increased. Where Bruner is defining instructional aspects on a general level, Jonassen and his colleagues are more specific in describing essential features of constructivist instructional design solutions.

Bruner stated that a good method for structuring knowledge should aim at simplifying, generating new propositions, and also facilitating a learner's manipulation of information. This is interesting with regard to technology enhanced learning, and it is similar to what Jonassen (1999) calls a "problem manipulation space" within the frame of constructivist learning environments. It also rimes well with what Spiro, Feltovich, Jacobsen and Coulson (1992, p. 64) say about instructional design in their cognitive flexibility theory. They discuss ways of developing "cognitive flexible processing skills" through accessing multiple perspectives on the same content. By approaching the same items of knowledge from a variety of different angles, we are better able to construct meaning of content which leads to comprehension and "advanced knowledge acquisition". They also state that "the computer is ideally suited, by virtue of the flexibility it can provide, for fostering cognitive flexibility" (Spiro et al., 1992, p. 58). What Bruner and Jonassen, as well as Spiro et al., suggest is that our manipulation of information helps us in building our understanding and makes us flexible in our thinking about a specific piece of information by providing us with multiple perspectives on information. Whereas cognitive views on learning focused on the internal processing in our minds, constructivist views began to include also the context of learning. For instance, Bruner (1990) included also social and cultural aspects of learning into his theory, which brings us to the next step in development of paradigms for learning.

Focus on socio-cultural interactions

Socio-cultural perspectives on learning view learning in relation to the context we live in, the tools we work with, and the social context we are a part of (Säljö, 2002). From this perspective, knowledge is seen as something that is meaningful only in relation to specific social contexts (Lilja & Lindström, 2002). Learning is based on the relation between the collective and the individual. All interaction between people allows for knowledge, skills, and values to be passed on to new contexts. The emphasis has shifted from a focus on the processes within the individual to focus on the individual in his/her social and cultural context. For instance, *Computer Supported Collaborate Learning* is a fairly new paradigm for research in the field of learning and learning technology, which uses the context of digital technology and social interaction as a means for learning (Stahl, Koschmann & Suthers, 2006). Säljö (2002) refers to Vygotsky as representing a socio-constructivist view on learning, as he described the resources in our social context as tools. These tools are both physical artefacts, as well as linguistic and intellectual. The tools mediate our reality, and create links between people, and both social, as well as physical contexts. From generation to generation, we learn to use these tools in order to manage in society. In socio-cultural theory, this form of learning how to manage tools is called appropriating (Säljö, 2002). Learning how to manage within an e-learning environment is one example of appropriating.

Our society is today highly specialised compared to, for instance, stone age society, where people basically had equal skills in all areas. Säljö (2002) is speculating in what ways our learning has changed due to the introduction of new technology in our lives. He suggests that when technological tools change, it also changes how we interact with the world around us, and also the way we learn and acquire knowledge. ICT has changed the way we communicate, behave and socialise. It provides a powerful tool for learning as well. Säljö discusses how ICT allows for new strategies of solving problems and provides an atmosphere of trial-and-error-testing for learning. This gives permission for error-making, which then is seen as a step in the process of learning instead of being judged as being right or wrong as an end-result. This is a fact that Säljö (2002) highlights as being of significance for how we learn, and learn to learn in new ways with the help of ICT. It is a socio-cultural perspective for understanding how human learning functions in terms of appropriating new tools in our environment, and the impact it has on our own evolution. Selander (2008) discusses this from a design perspective. He frames the concept of designs for learning in both socio-cultural theory and social semiotic theory on sign making practices. He argues that in order "to understand learning, we have to understand it as a sign producing activity in a specific situation within an institutional framing (ibid, 2008, p. 20), i.e. the learner creates his/her own signs of learning by using specific tools in a specific context (cf. Kress & Selander, 2010 on designs in learning). I want to emphasise this, since it is also what this research is aiming for: exploring how and why learners self-regulate in a self-paced e-learning environment, in which a new technological tool (the e-learning course) is used as a means for creating signs of learning. Since the participants were novice e-learners, it

becomes especially interesting to analyse their reflections on how they manage their learning, as well as the environment as such. In other words, the appropriation process is of interest, and how it facilitated their sign making (cf. Kress & Selander, 2012; Selander, 2008; Säljö, 2002).

Focus on digital connectedness

The theoretical paradigms influencing instructional design in the industrial age were driven by cognitive models of learning (Reigeluth, 1999), based on the concept that learning happens on an individual level (Siemens, 2005). This obviously served a purpose for that type of domain-dependent work-life. However, well into the digital information age, we need skills for more complex cognitive tasks. Much of our work involves problem-solving in ill-structured domains. Reigeluth (1999, p. 21) also points to the fact that people today often need to develop non-cognitive skills, "such as emotional development, character development, and spiritual development". Others emphasise the fact that most professions will include both information processing, networking, continuous learning, and new kinds of management of learning itself (Auvinen, 2013). When considering all types of learning, "it is clear that our current theories are not adequate. A new paradigm of instructional design theory must address how to support learning in all its varieties and forms" (Reigeluth, 1999, p. 21).

The digital connectedness that is evolving around us today is seen as the core of a new paradigm for learning, afforded by web 2.0 and social media. Siemens (2005, p. 7) describes this learning paradigm as connectivism, which he defines as "the integration of principles explored by chaos, network, and complexity and self-organization theories". He continues by describing learning as "a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual". From this perspective, what we know is less important than our ability to create connections that enables us to keep learning. Knowledge is not an end state, but something that is forever changing. Making decisions is a learning process in itself, in which up-to-date knowledge is the most valuable currency.

The concept of connectivism has great impact on how we can approach the design of learning technology, as it blurs the line between what is personal knowledge management and what is collective knowledge management. The expertise of individuals must be related to competences of the collective (Auvinen, 2013). This new way of thinking about our learning, based in connectivism, will have impact on how we design for learning in the workplace. However, the fact is also that learning often can no longer be separated from work itself and is to be regarded as a larger ecosystem for learning and performance (Rosenberg & Foreman, 2014). It becomes part of the daily routines, rather than being something that is managed as a separate process. The core of connectivism lies in building networks for continuous learning, skills for communicating, and digital affordances for the flow of knowledge management on a community-based level (Auvinen, 2013; Siemens, 2005).

2.3   Designing learning technology

The previous section presented a brief summary of how the design of learning technology has been impacted by prevailing trends and paradigms of learning theory. In this section, I will explore learning technology design on more concrete terms. Different types of e-learning solutions are discussed, as well as briefly describing the field of instructional design. Another topic in this section will be on the design dimension of e-learning environments. I will describe how researchers view successful e-learning content and context design, as well as the perspective of the field of human-computer interaction (HCI) design. However, I will firstly describe a model for learning design, which highlights and defines the various areas of expertise and knowledge required for the design of educational technology.

TPACK model for learning designs

TPACK is a model for the design of digital learning solutions. The acronym stands for *Technological Pedagogical And Content Knowledge* (Koehler & Mishra, 2008). It is a framework (Figure 2) often used for defining the expert knowledge teachers need in order to design and apply new learning technology. The framework is made of three types of basic knowledge related to technology (TK), pedagogics (PK), and content (CK). However, for the design and use of learning technology, these cannot be seen as separate. The overlapping becomes the crucial know-how. The knowledge represented by the centre including all the three areas, called TPACK, is the key to good learning design. I will shortly describe the knowledge areas. *Pedagogical Knowledge* (PK) involves knowing about both teaching methods and learning theory. *Content Knowledge* (CK) represents the subject matter to be taught. These two (CK+PK) combined comprise *Pedagogical Content Knowledge* (PCK), which is the didactic know-how about the principles teachers need for teaching a specific subject.

Technological Knowledge (TK) involves knowing how to flexibly use technology and adapt it in relation to contextual needs. *Technological Content Knowledge* (TCK) includes knowledge about both technology and content (TK+CK), and it represents how technology can be used in a specific subject to enhance the content matter. Thus, the content determines the use of technology. *Pedagogical Technological Knowledge* (PTK) represents general knowledge about affordances and constraints inherent in learning technology solutions. For PTK, one needs both knowledge about technology and pedagogy (TK+PK). However, to apply this general knowledge in a specific content, the full combination of TPACK is needed. This is where best practices of didactic know-how evolve: how technology is used flexibly in order to maximize the benefit and expand its potential for instructional use. The large surrounding circle represents the context, which will influence all of the areas in dynamic ways. This abundance of factors determining the outcome of learning designs is the core of why it is often defined as a 'wicked problem', to which there is no definite answer (Koehler & Mishra, 2008). The present study aims to expand TPK knowledge within a corporate context. However, no

claims are made for expanding content knowledge from a didactic perspective; that is, how to best teach the content of the course subjected to study. The focus is, as stated in Figure 1 in Chapter 1, to explore the participants' SRL in relation to the learning technology solution under development, and in the specific context of corporate e-learning.
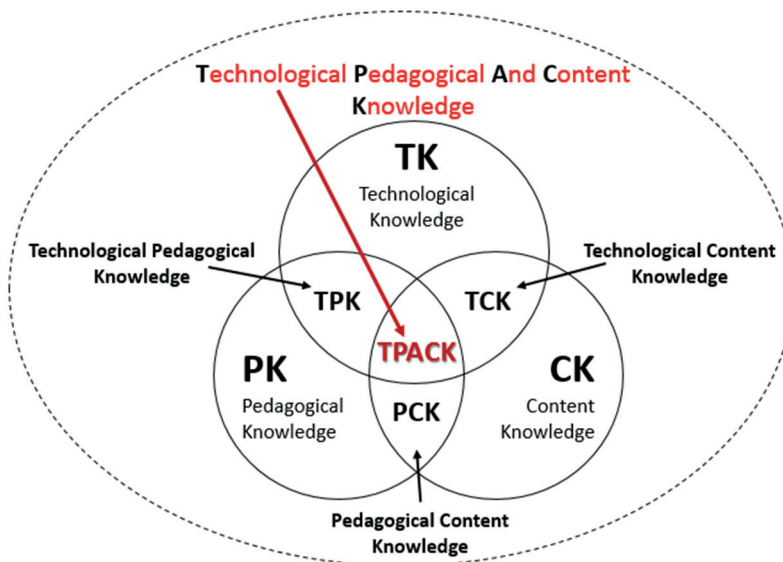
Figure 2   TPACK framework (adapted from Koehler & Mishra, 2008, p. 12)[1].

Types of e-learning solutions

Firstly, what is the usual design of an off-the-shelf self-paced course? Yost (2002) lists a number of features commonly provided in such e-learning solutions: skills assessment provides personally prescribed learning paths, preventing the learner from relearning knowledge already possessed, such as hands-on exercises to provide interaction and enhanced learning; questions that use different forms of answers (multiple-choice, true/false, etc.) to test the learner's knowledge; simulated environments in which to perform learned tasks; online access to mentors to answer questions as learners proceed through a course; real-time access to various types of online reference materials (e.g., books, white papers, etc.), and scoring to determine whether the material has been mastered.

E-learning content can be classified into five types: fact, concept, process, procedure, and principle. These classifications define the type of content from the perspective of the level of cognitive performance aimed for. These content types are similar to Bloom's

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[1] © 2012 by tpack.org

taxonomy of cognitive complexity (Forehand, 2005), in which different knowledge levels are categorised: remembering, understanding, applying, analysing, evaluating, and creating. Clark and Mayer (2003, p. 16-17) classify two types of e-learning: inform programmes, and perform programmes. Inform programmes are designed to share information, while performance programmes are designed to build specific skills. Performance programmes can, furthermore, be divided into two types based on their performance goals: procedural, or near transfer, where the content learned is very similar or identical to what is required for a specific job, and principle-based, or far transfer, where the tasks are ill-defined and do not transfer exactly to a specific job environment. There are at least three paradigms influencing the development of e-learning (Lee, Owens, & Benson, 2002). The first is the replication paradigm, in which material and instructional strategies are copied/replicated for web-based instruction. The second is the equal education paradigm, in which the aim is that the same educational goals and objectives can be achieved through face-to-face, as well as web-based instruction. However, here, the notion of equivalent learning experiences does not necessarily mean the exact same learning experiences. The third paradigm is the new domain paradigm, in which there is a belief that digital instruction can add a new dimension to any learning experience. This new dimension cannot be achieved in either traditional learning, or in traditional distance learning. It enables us to engage in new forms of educational interactions.

Over fifty years of comparative research on instructional media have not provided any results showing that one instructional delivery method is better than the other. Whenever the same instructional methods are used, there is no difference between learning outcome, regardless of which media were used for instructional delivery. This is often referred to as the no-significant-difference-phenomenon in learning effectiveness when comparing technology-enhanced learning solutions with traditional face-to-face methods. However, researchers (Joy & Garcia, 2000) argue that such studies are often inadequate, regarding both methodologies and conclusions. Asking generally which media are most effective for learning is simply the wrong question. The most important question to ask is rather how we should combine instructional methods and technology for delivery in order to target a specific learning outcome for a specific group of learners. One suggestion, providing a hint for answering this question, is to avoid designing content with instructional methods copied from other modes of delivery. This was attempted in a study comparing learning from a text printed on paper with the exact same text scanned and read on the computer. The results showed that the computer-version lost regarding both measured understanding and interest (Murphy & Holleran, 2004).

Instead of presenting the same material – only in the new frame of computer screens – we need to explore the added value of each new media alternative and how these can support human learning (Clark & Mayer, 2003). However, unfortunately, how we design a learning environment is to a great extent predetermined by situational constraints, or by the participants themselves. This fact makes it many times difficult to design what we

call "authentic learning environments", although that is what we might be aiming for (Wilson & Meyers, 2000, p. 77).

Instructional design

Instructional design involves design, testing, evaluation and instructional improvements, according to learner needs, in developing a specific end-product (Berger & Kam, 1996). Instructions are referred to as "a set of events embedded in purposeful activities that facilitate learning" (Gagne, Wager, Golas & Keller, 2005, p. 1). It is usually guided by various design models such as the ADDIE-model[2], which illustrates specific steps of design (Gagne et al., 2005). The purpose of the ADDIE-model is to define the steps for creating instructions that facilitate learning.

David Merrill and his colleagues (Merrill, Drake, Lacy, Pratt & ID2 Research Group, 1996) claim that the purpose of instructional design is to ensure efficiency, effectiveness, as well as an appealing product. They argue that we should build on what we know about learning strategies in order to design instructional systems that guide us towards successful learning.

> Instructional design is a technology which incorporates known and verified learning strategies into instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing. (Merrill et al., 1996, p. 2)

The main goal of the instructional design of self-paced e-learning is to empower learners regardless of their knowledge background, e-learning experience, or preferences for learning (Gagné et al, 2005). We want to be able to provide e-learning solutions that have high learnability, flexibility and robustness, which make for easy learner adaptation (cf. Dix et al., 1997). This concerns the three dimensions of learning that Illeris (2007) describes: the content, social context and maybe most important, the motivation of the learner. Jahnke and Kumar (2014) rather use the term didactical design instead of instructional design, as they claim the later to lack to take the dimension of social relations into account in the design. They refer to the following definition of didactical design:

> We define a didactical design as a design that focuses on fostering students' learning. It involves the formulation of teaching objectives, the plan for achieving those objectives so that the learner develop competencies and skills that correspond to the teachers' learning goals, and different forms of process-based, formative feedback and assessment to foster the learning progress of students (Biggs & Tang, 2007). (Jahnke & Kumar, 2014, p. 82)

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[2] Gagné and Briggs (1974) started their work on instructional design theory during World War II. They were the first ones in modern history to do research on instruction for improving learning. They presented a five-step model, which is commonly called the ADDIE-model because of its components: analysis, design, development, implementation, and evaluation.

In the case of self-paced e-learning, the social context is represented by the technology-enhanced learning environment. The purpose of instruction is to facilitate our understanding of a targeted content (Gagné et al., 2005), and also our self-regulation in learning, i.e. our ability to regulate our learning process, which involves how we develop strategies for our actions in order to learn (Azevedo & Cromley, 2004). I argue that the facilitation of learners' self-regulation becomes especially important in self-paced e-learning solutions, in which the computer-based environment acts as the sole mediative agent to guide and instruct the learner.

One of the challenges in designing software for learning environments is achieving the right balance of instructional guidance and learner control (Holmes, 2007). We want e-learners to have high levels of autonomy and independence (Jonassen et al., 1997). This makes them self-directed in their learning: they know which direction to take in their learning. In order to support their self-directedness we need to provide orientation (Gibson, 1998) and guidance, as well as instructions and logical tools for helping them to develop strategic initiatives (Jonassen et al., 1997): learning how to learn with new tools.

Instructional designers are the practitioners in the field of e-learning design, and they are starting to realize that the job of designing an e-learning course is not only about delivering material to be taught, it concerns managing a learning experience. Matthew Moore wrote a post in the LinkedIn group, The eLearning Guild's discussion forum (December 30th 2009), titled: "Do we need to move from instructional design to experience design?" The topic generated 80 comments in 15 days, which is an unusually high amount of comments[3]. Is there a paradigm shift taking place? If so, is this due to the fact that so much e-learning has failed its purpose – especially in industry? A new paradigm is entering the design world. It focuses on the end-users' experiences, emotions, and motivations. Concepts such as emotional design (cf. Norman, 2003), experience design (cf. Hassenzahl, 2010), and motivational design (cf. Keller, 1983; 2010) are crossing disciplinary borders. Gamification is one example of how the motivational triggers inherent in games are used for other purposes, such as learning, marketing, brainstorming, etc. However, it is beyond the scope of this thesis to cover these further.

2.3.1 Design dimensions of learning technology

Throughout the history of learning technology, the most consistent question has been what constitutes a good design. I have investigated the literature on successful e-learning solutions and suggestions for effective and efficient instructional design for e-learning

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[3] From a quick glance at the discussion forum, 0-8 replies seems to be the normal number of comments in this forum.

environments; a number of design dimensions have been highlighted by different authors and will be described briefly in the following.

Content display and structure

One dimension of the e-learning environment consists of concepts and content. It is the material to be explored and learned (Garzotto, Retalis, Cantoni & Papasalouros, 2004; Illeris, 2007). Stating clear objectives for the content will give learners a feeling of control, as well as providing them with the possibility of forming ideas about what will be coming. When we identify what is to be learned, learners know what to expect and are able to see how this particular content fits into their lives. It is also important to remind learners of past knowledge so that they can build new knowledge structures by integrating new information with what they already know (Ritchie & Hoffman, 1997). Another aspect is the quality of course content. The content and the practice questions should match. The content should also match the objectives of exams that the course is training the learners for (Yost, 2002). Furthermore, Jonassen (1999) highlights the importance of firmly rooting content within a context. The importance of context will be discussed thoroughly in Chapter 3 on self-regulated learning.

The limits of the human working memory and how this frames our possibility for taking in information is an essential aspect to consider in content design (Mayer & Moreno, 2003). This is referred to as the notion of cognitive load: "Cognitive load theory is concerned with the manner in which cognitive resources are focused and used during problem-solving and learning" (Leahy, Cooper & Sweller, 2004, p. 91). There are two kinds of cognitive load: intrinsic and extraneous. The intellectual complexity inherent in the content, which cannot be compromised, places a so-called intrinsic cognitive load on the learner. The extraneous cognitive load can be altered, as it has to do with how the content is presented, that is, its instructional design (ibid, 2004). However, Kalyuga (2011, p. 110) argues that cognitive load theory needs to take affective and motivational factors into consideration, as this could "enhance the effectiveness and efficiency of learning environments".

In order to find research on affective load similar to the concept of cognitive load, we need to step into the field of information searching behaviour (Nahl, 2004; 2005). Nahl defines affective load as "a theoretical concept that attempts to identify, measure, and chart the cumulative emotional cost involved in personal adaptation and engagement with technological affordances" (Nahl, 2012, p. 175). Nahl (2004) developed a questionnaire that measures affective load by a compound variable, including several dimensions of affect: "need, preference, attitude, task motivation, expected and felt effort, uncertainty, self-efficacy, optimism, relevance, satisfaction, and acceptance of or loyalty to the system" (ibid, 2004, p. 191). The short formula of affective load is "uncertainty intensified by felt time pressure" ($AL = U \times TP$) (Nahl, 2004, p. 195). The uncertainty-factor measures four negative emotions added together: irritation, anxiety, frustration, and rage, while the time pressure-factor measures expected length

subtracted from felt length. However, this compound variable of affective load is counteracted by users' coping skills, which include self-efficacy feelings as a searcher, plus optimism (UCS = SE + Op). Similarly, Lee and Hwang (2007) see computer self-efficacy as an important aspect of SRL. The affective load theory is based on a socio-cultural perspective on how affect and cognition are regulated for information behaviour by socio-cultural norms. However, the interrelated dynamics of cognitive load and affective load needs to be further explored (Nahl, 2004; Kalyuga, 2011).

Interactivity and activity

One dimension involves levels of interaction made possible within the environment: for instance, different ways to interact with the content, other students/peers, and teachers/trainers (Garzotto et al., 2003). The level of interaction learners are exposed to affects their engagement and meaning-making (Kress & Selander, 2012). Yost (2002) suggests that the course environment should require learners to answer questions or perform tasks on intervals sequenced between 5 to 10 screens. Interaction requires activity, which is another keyword in instructional design of e-learning solutions. It concerns how we become engaged and activated by the content and context, on the one hand (ibid, 2003). On the other hand, interaction in terms of social interaction, forms a base for making meaning (Kress & Selander, 2012).

Jonassen (2000, p. 91) advocates that instructional designers should aim for facilitating active, constructive, and authentic learning. We want to facilitate active engagement and the active involvement of learners (Gibson, 1998; Ritchie & Hoffman, 1997). Reed and Francis (2001) argue that there is a difference between e-learning and a-learning. They see the main difference as keeping the learners active in their learning. According to them, activity and interactivity is promoted when certain instructional design guidelines are followed. For instance, in creating content we should focus on concrete skills instead of abstract concepts, depend on exercises for knowledge building instead of on definitions, use interactive exercises to relay ideas instead of models and graphs, place emphasis on successfully completing work tasks instead of on tests and quizzes to quantify and measure learning, and finally support collaborative activities instead of supporting independent learning. Davis and Wong (2007) note that speed and involvement are important factors when designing with the aim of increasing experiences of flow in an e-learning environment. According to them, the most effective way to facilitate active participation and deep involvement is to provide a system that combines features for spontaneous user-content interaction while presenting key content in an interesting way.

Manipulation options

Jonassen (1999) emphasises the importance of including features enabling manipulation of information. He calls this "the problem manipulation space" in the instructional design of e-learning. What he advocates is mindful learner activity facilitated by the

environment through the possibilities of manipulating something on the screen. This will help learners gain ownership of the problems they encounter in the assigned material. The concept *Direct Manipulation* was coined by Shneiderman in 1982. It is based on the interactive technique of rapid feedback on users' actions. I find this interesting in relation to my research, as I am targeting the actions of the end-users in terms of self-regulation of learning. This concerns how the users manipulate the environment for their own learning. Shneiderman highlights a number of features as being of importance for a direct manipulation interface (Dix et al., 1997, p. 162):

- Visibility of the objects of interest
- Incremental action at the interface with rapid feedback on all actions
- Reversibility of all actions, so that the users are encouraged to explore without severe penalties
- Syntactic correctness of all actions, so that every user action is a legal operation
- Replacement of complex command languages with actions to manipulate directly the visible objects (and, hence, the name direct manipulation)

Schneiderman's criterion for direct manipulation is approaching it from the point of view of computer interface design, while Jonassen sees it from the perspective of learning. In other words, Schneiderman says how to do it, while Jonassen says why to do it for the benefit of learner.

Cognitive support, feedback, and evaluation

Facilitating learning is, of course, the essence of any learning environment. In an e-learning environment, where the learner often is working independently, we want to be able to provide cognitive scaffolding for understanding and integrating the content. In other words, we want to provide features and tools that "help guide learners to effectively process and assimilate new knowledge and skills" (Clark & Mayer, 2003, p. 17). Such features are often referred to as affordances of the e-learning solution, in contrast to constraints, which are factors that hinder learning. Jonassen et al. (1997) mention contextual affordances as logistical support tools with the purpose of facilitating the analysis and synthesis of information.

> Cognitive tools may be organization tools for analyzing ideas, dynamic modeling tools for creating representations of their mental models, visualization tools for helping to see phenomena in different ways, conversation tools for enabling them to build collaborative knowledge bases. (Jonassen, 2000, p. 96)

In accordance with these suggestions for cognitive tools, Yost (2002) also argues that a good e-learning course should include simulations that provide opportunities to practice content. Encouraging reflection is one way of providing cognitive support for learning. Feedback that acts as metacognitive support includes features that give learners opportunities to reflect on their learning progress and the way they are using self-regulated learning strategies successfully (Azevedo & Aleven, 2013). Larsson (2001) mentions two different ways of providing feedback for reflection in e-learning

environments. The first is called explicit feedback for reflection. This is when the instructions are referring to a person or a task for information. Implicit feedback for reflection is a programme's adaptability to a user's choice of action or level of understanding. Tolboom (2012) suggests that feedback works best when it pertains to tasks, in contrast to feedback targeting the learners themselves. The latter kind of feedback should be avoided according to Tolboom, as it becomes personal instead of being functional. Meta-analysis of feedback in computer-based learning environments has shown that immediate feedback brings "the best instructional advantage" for learners (Azevedo & Bernard, 1995, p. 122). However, Mason and Bruning[4] suggest that there seems to be no single solution for feedback that is applicable in all situations. Factors that are to be considered when designing for feedback in technology-enhanced learning environments are: the nature of the task, the achievement levels to be reached by learners, as well as levels of prior knowledge. Furthermore, other factors also play a role in the design, such as learner control and their attitudes toward feedback, and also what kind of demands there are for levels of efficiency (ibid, 2014). Kress and Selander (2012) argue that as the agency of students change, also the roles of teachers change with regard to feedback and assessment:

> The change in agency marks a different social relation of teacher and learner: and it will lead to a reassessment of the teacher's role. Assessment is no longer only about evaluating in relation to certain standards, but far more a question of "feed up", "feed back" and "feed forward" to facilitate the learning in a broader sense (Björklund Boistrup, 2010; Black & Wiliam, 2009). (Kress & Selander, 2012, p. 267)

Testing comprehension can be done in a number of ways and is inevitably influenced by the conception of learning the designer has (cf. Duffy & Jonassen, 1992). One recommendation is to evaluate authentically (Gibson, 1998). This can be done by placing emphasis on completing tasks to quantify learning, instead of on tests and quizzes (Reed & Francis, 2001). This is also recommended by Sims-Knight and Upchurch (2001), who argue that informational feedback has been shown to be counterproductive and takes away attention from the actual learning. They suggest, similarly to Azevedo and Aleven (2013), that the key lies in helping learners to assess and reflect on their own learning, which facilitates self-regulation, and hence, also metacognitive regulation strategies. Yost (2002) advocates tests and assessments as important ingredients of good self-paced e-learning. Examples given are practice questions (e.g., multiple-choice, fill-in-the-blank, or true/false), skill assessment, pre-tests and post-tests that help determine current skills and mastery of content, as well as feedback given in terms of scores on level of performance. Mayer and Moreno (2003) distinguish between retention tests and transfer tests. The first is to test memorisation of learned material, while the latter is to test how the information learned can be transferred to a new situation for solving problems.

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[4] online source without publication date available, accessed April 25th 2014

While these are practical suggestions for learner assessment, Kress and Selander (2012) want to highlight how power changes in the presence of learning technology, and this is especially evident in terms of assessment. Learning is about interpretation, meaning-making, and expression of this transformative process in various ways. Assessment needs to acknowledge the agency of the learner in his/her interpretation. The recognition of learning through assessment, hence, becomes a question of power.

Motivating learners

It is important to acknowledge the affective as a psychological dimension in the design of e-learning solutions (Jonassen et al., 1997; Zariski & Styles, 2000). According to John Keller's ARCS-model of motivational design, there are four steps for promoting and sustaining motivation in the learning process. Catching the *attention* of the learners and evoking their interest can be done either by perceptual arousal (e.g., surprise) or by inquiry arousal (e.g., curiosity). *Relevance* in the subject has to be conveyed to the learners in order to increase motivation. This can be done by discussing the present and future usefulness of the subject, relating it to the learners' own experiences and skills, or provide models elsewhere. Allowing for choice in task completion is also important for enhancing the feeling of relevance. By supporting their self-efficacy, that is, their belief in their ability for success, the learners' *confidence* is strengthened. For this, objectives and prerequisites are essential, so is feedback on actions and progress, as well as feelings of control over the learning situation. Feedback and reinforcements are also important for obtaining *satisfaction* from learning and achievement.

Instructional designers need to know as much as possible about the target group of the design (Gibson, 1998). This makes it easier to focus on the specific preconditions of the learners in knowing how to motivate them. Wang and Han (2001) discuss instructional features for enhancing learner motivation and emphasise that design strategies need to be flexible and should be modified and adapted according to situational factors and contexts. They list six factors to apply to instructional design based on the work of Turner and Paris (1995): choice, challenge, control, collaboration, constructing meaning, and consequences. *Choice* stands for providing students with choices of assignments which are close to their own areas of interest, in order to increase their intrinsic motivation for attempting a task. Designing instruction to push learners just beyond their own skill level provides *challenges* that motivate. Allowing the learner to be involved in *controlling* the learning situation to some extent will encourage responsibility, independence, and self-regulation. Social interaction, communication and *collaboration* are key processes for students sharing both perspectives on content as well as concrete learning strategies. *Constructing one's own meaning* of content is the process of gaining ownership of new things learned. Personally constructed meanings are related to personal value systems. *Consequences* which provide acknowledgement of achievements and recognition of efforts taken are also part of motivating learners. Ritchie and Hoffman (1997) call this enrichment or remediation.

Flexible modes of delivery

A flexible learning environment allows the learner to create their own learning trajectories (Brand-Gruwel, Kester, Kicken & Kirschner, 2014). Modes of delivery refer to options of accessing content from a technological point of view, and also the form in which content is presented. One suggestion for increasing learning effectiveness is to use mixed modes of delivery, including, for instance, face to face interaction (Zariski & Styles, 2000). Instructional methods and strategies for delivery might provide certain restrictions when it comes to options. However, e-learning might also provide for options that traditional learning environments cannot provide. Khan (2003) gives a whole range of examples of delivery options for e-learning solutions: presentation, demonstration, drill and practice, tutorials, games, storytelling, simulations, role-playing, discussion, interaction, modelling, facilitation, collaboration, debate, field trips, apprenticeship, and case studies. The different teaching methods are more or less applicable depending on the content, context, target group, as well as the demands of the learning task at hand. Using narrative form (story line) of delivering content is one way of motivating learners (Larsson, 2001). Providing choices and variety (Gibson, 1998; Khan, 1997) in the learning environment makes the layout more adaptable according to learning style (Larsson, 2001). A visualise-simulate-model division of instructional design is described by Larsson (2001) as a way of presenting information in e-learning environments, depending on the level of knowledge one wants the learners to acquire, or the prior knowledge level they possess. Visualising is to show or see, simulating is to test and try it out oneself, and modelling is to understand the theory behind a phenomenon. A beginner's approach is to go from visualising to simulating to modelling, while reversing the order will demand more background knowledge of the learner. This approach can be related to the discussion of the difference between verbalising information before practicing, as presented by Gagné, as opposed to Jonassen's adaption of activity theory for designing student centred learning environments, where practice will come first in order to understand concepts: a problem-based learning approach. This is an example of how the objectivist or constructivist perspective is applicable depending on the context and prior knowledge of the target group.

Technical support and accessibility

One cannot escape the fact e-learning inevitably goes hand in hand with creating technical difficulties for both learners and teachers/trainers. We have to assume that most end-users of e-learning solutions are not technically trained in the field of ICT. Knowing what problems and issues might arise and how to deal with them ensures high accessibility (Peters, 2013). It is important to address deficiencies in the digital environment, as well as provide initial and ongoing technical support (Zariski & Styles, 2000) that is fully integrated within the course environment (Gibson, 1998). However, it is not only about technical issues. It is likewise just as important to achieve an understanding of the nature of the electronic environment and how it changes the

dynamics of learning, communicating, and collaborating. How do we as novice e-learners, for instance, learn the discipline and protocols associated with successful online communities and digital interfaces? Therefore, technical support is not only about solving technical problems, but how the context intelligently scaffolds the learner in learning how to manage within the environment. While accessibility describes how accessible the learning technology solution is to the intended end-user, usability refers to a user-friendly design of the interface.

Usability

Usability as a concept is most often defined as the efficiency, effectiveness, and satisfaction of a product (Bevan, 2008). The efficiency of using a system relates to the time it takes to complete a task. Effectiveness, on the other hand, relates to how well the users of a system are able to achieve the intended goals. Satisfaction is related to the level of engagement the user is experiencing from interacting with a system (Quesenbery, 2001). There are obvious similarities between the usability concept and the aims of Merrill and his colleagues (1996), who said that instructional design should be "efficient, effective, and appealing". Similarly, Yost (2002) mentions efficiency, smooth delivery, the look and feel of the navigational design of the course environment, as well as how logical and easy it is to use it, and allow for the transfer of strategies throughout the whole course. This perspective explores e-learning from the usability perspective of computer interface design. What are the factors that make an e-learning system easy to use? In their book Human Computer Interaction, Dix and his colleagues (1997) discuss three main categories of principles for how a computer-based domain can be designed to support usability. These three are: *learnability, flexibility,* and *robustness*. I will explain these concepts briefly.

Learnability of an interactive computer-based system is "the ease with which new users can begin effective interaction and achieve maximal performance". Learnability can be divided into predictability, synthesisability, familiarity, generalizability, and consistency. *Predictability* is an important part of learnability. It is determined by how one can predict one's actions within the environment based on past interactions. *Synthesisability* is about one's ability to "assess the effect of past operations on the current state". *Familiarity* is about the extent to which a user's knowledge and experience in other real-world or computer-based domains can be applied when interacting with a new system. How the user is supported in extending "knowledge of specific interaction within and across applications to other similar situations is defined as the *generalizability* of a system", while *consistency* is described as the "likeness in input-output behaviour arising from similar situations or similar task objectives" (Dix et al., 1997, p. 162).

Flexibility refers to "the multiplicity of ways the user and system exchange information". Flexibility consists of dialogue initiative, multi-threading, task migratability, substitutivity, and customizability. Dialogue initiative is about allowing "the user

freedom artificial constraints on the input dialog imposed by the system". *Multi-threading* is about the "ability of the system to support user interaction pertaining to more than one task at a time". *Task migratability* is about "the ability to pass control for the execution of a given task so that it becomes either internalized by user or system or shared between them". *Substitutivity* is about "allowing equivalent values of input and output to be arbitrarily substituted for each other". *Customizability* is about the "Modifiability of the user interface by the user or the system" (Dix et al., 1997, p. 162).

The *robustness* of an interactive system is defined by "the level of support provided to the user in determining successful achievement and assessment of goals". Robustness consists of observability, recoverability, responsiveness, and task conformance. *Observability* is determined by how the systems make it possible for "the user to evaluate the internal state of the system from its perceivable representation". *Recoverability* is to what extent the system allows "the user to take corrective action once an error has been recognized". *Responsiveness* is "how the user perceives the rate of communication with the system". Finally, *task conformance* is "the degree to which the system services support all of the tasks the user wishes to perform and in the way that the user understands them" (Dix et al., 1997, p. 162).

All these terms and their contextual meaning in relation to computer-based systems give us clues for the instructional design of e-learning environments. It gives us a usability perspective of the human-computer-interaction seen from the interface designer's point of view. However, the usability concept needs to be extended when used in the context of e-learning. Nokelainen (2006) tries to define a measure for pedagogical usability and argues that the main question to address is whether the system enables teachers and students to obtain the required goals of learning and teaching. He has developed a questionnaire that measures both pedagogical and technical usability, and thus attempts to bring a multidisciplinary perspective by combining HCI and education. The questionnaire targets *learner control, learner activity, cooperative/collaborative learning, goal orientation, applicability, added value, motivation, valuation of previous knowledge, flexibility,* and *feedback*. However, the questionnaire has so far not been adapted for the context of adult learning.

A brief comparison of the dimension listed by Dix and his colleagues (1997) shows that the learnability of the system as such is not covered in Nokelainen's questionnaire, which only focuses on the content to be learned and how the system supports this learning goal, but not how to learn to use the system itself. Flexibility, as referred to by Nokelainen (2006), includes optional routes for progress, which is similar to how Dix et al. (1997) describe flexibility. However, Nokelainen also includes repetitive tasks as part of flexibility, which is what Dix et al. refer to as familiarity, being one of the dimensions of learnability. Robustness can be compared to Nokelainen's dimension of feedback, and also partly to the dimension of applicability, as this last dimension includes, for instance, prompting, fading, and scaffolding affordances. Nonetheless, the comparison is not easily made as the dimensions overlap.

As already mentioned, the purpose of Nokelainen's questionnaire is to measure how the system functions for learning a specific content – not for learning how to use the system. However, I argue that these aspects are two sides of the same coin, which are both contributing to the total learning experience. I do not see how learnability of the system can be left out when we introduce a new learning technology to novices. Nokelainen (2006) refers to his questionnaire as a self-evaluation of learners' and teachers' subjective user experiences from interacting with an e-learning solution. The term user experience within HCI is rather new, and used in sometimes contradicting ways. There is, however, a difference between the usability of a system and the user experience of a system.

User experience

User experience research within the field of HCI can be defined as the experience of interaction with any kind of a technology-based artefact. The concept of an experience is, of course, broad and allows for multiple interpretations. HCI research of interaction between end-users and technology has to a large extent focused on the usability of the technology product per se. At first, the focus of HCI was on adapting technology to the limitations of our body, such as the design of keyboards to fit our fingers. The limitations of our cognition is another aspect. For instance, cognitive overload is avoided by designing interfaces that are suitable for our ability to perceive stimuli and process information (Stewart, 2008; cf. Leahy et al., 2004). As usability research targets the ease of use and functionality of a product, the emphasis is placed on the physical product and whether it works or not (Hassenzahl, 2008). The rapidly growing field of research into user experience extends beyond this technical aspect into human emotions and needs and how these are affected by and related to the use of technology and new media solutions. However, without good usability, there will most likely not be a good user experience either, as these concepts are interdependent.

According to basic theories of psychology, our needs are drivers of behaviour; our needs motivate our choices (e.g., theories of Maslow). Knowledge about the subjective user experience is essential for research aiming to understand the needs of the end-users, and a powerful tool for improving the design of products (Hassenzahl, 2001), and this includes educational technology and instructional design of e-learning as well. This is in line with how Marton and Booth (1997, p. 16) describe how we need to carefully examine learners subjectively, in order to understand their learning: "we have to ask learners what their experiences are like, watch what they do, observe what they learn and what makes them learn, analyse what learning is for them." In HCI research, the learner is the end-user of a technological product. Based on Marton and Booth's thesis, it becomes essential to investigate the end-user's total experience of the e-learning situation in order to know which factors influence the learning process.

User experience research, as an investigation into end-users' subjective experiences, usually targets the fulfilment of universal needs, such as, for instance, a need for autonomy, meaning, competence, relatedness, popularity, stimulation, and/or security

(Hassenzahl, 2010). We know from earlier research into intrinsic motivation that at least three of these fundamental needs are essential for how we regulate our activities and motivation for learning, i.e., autonomy, competence, and relatedness (Deci & Ryan, 2000). This research points to the fact that our motivation for learning is at its highest when we act from joy and interest, and that is exactly what a positive user experience entails according to user experience specialists (Batterbee, 2004; Hassenzahl, 2010). It suggests that the affective dimension of the subjective user experiences of e-learners needs to be explored in addition to a cognitive dimension, and thus needs to go beyond the goal dimension (cf. Nokelainen, 2006) to include learners' emotions. This is also in line with prior research on self-regulated learning, categorising the four important areas of SRL to be cognition, affect, behaviour, and context (Pintrich, 2000; 2005), of which affect is the area least explored (Azevedo & Alevene, 2013). These areas will be scrutinized in Chapter 4.

3   Educational design research

The second pillar of this study (see Figure 1), educational design research[5], is presented in the following. First, I will briefly touch upon e-learning research in general, and then define what educational design research is. I will scrutinize this research genre in relation to learning technology design and how it frames the iterative design and the investigation of the selected e-learning course. Finally, I will position the present study within this research genre, by emphasising the terminology and context.

E-learning research in general

Learning technology has been around for centuries. Even clay tablets or handmade paper can be regarded as technological tools used for learning. It has been studied both from the perspective of how these tools are used, i.e. the instructional design based on a specific educational tool, or from the perspective of the way the educational transaction is altered by new tools, enabling new ways of acting, interacting, and learning (Garrison & Andersson, 2003). The latter perspective is similar to a co-evolutionary view of e-learning (Andrews & Haythornthwaite, 2007). E-learning as a field of research is cross-disciplinary by default. It has been informed by a variety of scientific traditions both regarding theories and methodologies. The obvious traditions of influence are perhaps educational and psychological research, as well as human computer interaction (HCI) and informatics, but these are not the only ones. The outcome of e-learning research are theories, tools, activities, and design methods and models, in order to improve the design of e-learning environments. This means that learning scientists step into the field of designers (Hoadley, 2007).

Hoadley (2007) elaborates on the relationship between e-learning research and research in the learning sciences. Learning sciences are an interdisciplinary field, which explores the design of learning environments (often technology-supported environments) by studying them in context. The goal is simply to design better learning environments by exploring what works and what does not work. Learning sciences are committed to a number of theories, such as cognitive theories, situated learning theories, and constructivist theories of learning and pedagogies. In the case of the latter, the research might, for instance, focus on how learners can be supported in various ways in order to construct understanding. According to Hoadley (2007), empirical, systematic collection and use of data support the refinements and development of theories and/or design models in e-learning research. A pluralist view of research methods is beneficial for this purpose. This is often the methodological approach chosen by learning sciences.

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[5] Educational design research is a synonym for design-based research and formative research, as well as designing experiments and development research (McKenney & Reeves, 2012).

3.1   What is educational design research?

From a heavy debate in the 1990s between positivists, cognitive understanding of learning, and situated, socio-cultural views on learning, arose a fruitful blending of design theories, as well as new research methods. Brown (1992) wrote a paper on her attempts on what she called design experiments in the classroom. The aim was to "engineer innovative educational environments and simultaneously conduct experimental studies on those innovations" (ibid, 1992, p. 141). Examples of the use of design theoretical approaches for educational development are design-based research (Hoadley, 2007), educational design research (McKenney & Reeves, 2012), and formative research (Reigeluth & Frick, 1999), which all aim at understanding a learning situation by trying to change it. This kind of research approach allows for tool refinement in an e-learning environment as a side effect of social science research.

In my attempt to frame the present research study, I have chosen to use the term educational design research, as McKenney and Reeves (2012) describe it. They argue for the term, as it refers to the notion of researching educational design, that is, design aimed to be used for educational purposes, whereas, for instance, design-based research leads the mind towards the concept of any kind of design, and the term formative research merely refers to a methodological description. However, in the following, I will briefly discuss all of these three concepts in order to form a wider frame of reference for this kind of research approach.

Design theories tell us "how to do" education, not what it is. When quantitative research methods fell short in providing data for improving educational practices, researchers began to use both formative evaluation and case study techniques as a way of exploring new methods to answer more broad questions pertaining to these interests: for instance, what methods worked well? What did not work well? What improvements can be made to the theory? (Reigeluth & Frick, 1999, p. 636). Hence, the name formative research, as the new methodological approach was guiding the research. Innovative and multiple methods are often used in these kinds of studies (McKenney & Reeves, 2012), and technology in itself has allowed for new ways of approaching and analysing data (Bazeley, 2006; Bazeley & Kemp, 2012).

Design-based research considers learning contexts to be unique, which makes predictions in research difficult. Further, it is considered that interventionist manipulation is a key to making empirical claims in the process of finding design solutions for learning problems. All this has challenged both positivist and experimental methods, which aim at predictions and generalisations, as well as qualitatively focused methods, which aim at understanding and interpreting human activity (Hoadley, 2007). It is defined by the Design-Based Research Collective (2003: 5, in Hoadley, 2007, p. 147) as:

> An emerging paradigm for the study of learning in context through the systematic design and study of instructional strategies and tools ... We propose that good design-

based research exhibits the following five characteristics: First, the central goals of designing learning environments and developing theories or 'prototheories' of learning are intertwined. Second, development and research take place through continuous cycles of design, enactment, analysis, and redesign (Cobb, 2001; Collins 1992). Third, research on designs must lead to sharable theories that help communicate relevant implications to practitioners and other educational designers (cf. Brophy, 2002). Fourth, research must account for how designs function in authentic settings. It must not only document success or failure but also focus on interactions that refine our understanding of the learning issues involved. Fifth, the development of such accounts relies on methods that can document and connect processes of enactment to outcomes of interest.

One important aspect of design-based research is that the focus is on real world problems in order to facilitate learning – not on comparing pedagogical approaches to see which one works best (Barab & Squire, 2004; Herrington, Herrington & Mantei, 2009). Similarly, the purpose of educational design research is to give insights into how changes in a learning design affect outcomes of learning, and ultimately, to disseminate this knowledge to the practitioners in the field. In other words, educational design research aims at bringing a deeper understanding of how to best design for learning (McKenney & Reeves, 2012, p. 7):

> Educational design research can be defined as a genre of research in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigation, which yields theoretical understanding that can inform the work of others.

Due to the technologically framed context of e-learning, the design perspective becomes obvious. Formative research, a synonym education design research approach, has been used for the design of computer-based simulations, as it works well for the iterative design process of educational technology (Reigeluth & Frick, 1999). The design process is executed through testing iterations of an educational design solution in order to learn about how the changing iterations of the design alter benefits for learning. The goal of feeding back to theory is at the core of the educational design research effort. However, it also includes the aim of the practical improvements of the solution in addition to the theoretical contribution (McKenney & Reeves, 2012).

According to Reigeluth and Frick (1999, p. 633-4), this kind of research "is intended to improve design theory for designing instructional practices or processes" and is similar to action research. However, action research is primarily focused on improving one specific case only, which makes it different from educational design research or formative research, as the theoretical contribution in that case is the guiding light of the study (McKenney & Reeves, 2012). Instructional design is not equal to educational design research, as the focus is on the practical design. As such, theory is important, but used from the perspective of informing the design of a specific product (Berger & Kam, 1996). Educational design research differs from this regarding the aim of informing theory as well (McKenney & Reeves, 2012).

3.2   Positioning the study as educational design research

The present research is highly involved in the developmental process of a learning technology design, but approaching it from the learner's perspective of needs and self-regulation, rather than from theoretical perspectives on solutions to instructional problems. Thus, the results are framed by theories of self-regulated learning (SRL). Conclusions about learner needs and SRL will be drawn in relation to these theoretical perspectives. Hence, the purpose of this research is, in accordance with educational design research, to contribute to educational design theory from a SRL perspective (cf. McKenney & Reeves, 2012).

There are many aspects that can be used for describing the educational design research process. It can be described as: "adaptive, collaborative, contextual, flexible, goal-oriented, grounded, integrative, interactive, interventionist, iterative, methodologically inclusive, multilevel, pragmatic, process-focused, theoretically transformative and utility-oriented" (McKenney & Reeves, 2012, Chapter 1 under the heading Characterizing Educational Design Research[6]). Most of these descriptors can be used for describing the present research study as well:

-   it is *adaptive*, as the e-learning course was adapted in accordance with the needs of the first group of participants;
-   it is *collaborative*, with regard to the need for collaboration between software developers, subject matter experts, researchers, as well as input from participants;
-   it is *contextual*, as the context is the number one influencing factor for how the learning technology needs to be designed: who are the end-users and what is the purpose of the designed solution?
-   it is *flexible*, as the design is changed in flexible ways in order to see how it can be improved, but grounded in the practice of real participants and their reality;
-   it is *goal-oriented*, as it strives for improvement of practice and development of theory;
-   it is *interactive*, as the participants' own interactivity with the learning technology shows the way towards improvement;
-   it is *interventionist*, as the research results are used for intervening with the learning technology design;
-   it is *iterative*, as the design is redeveloped into a new iteration of the same learning design solution;
-   it is *methodologically inclusive*, as multiple methods are used pragmatically in order to frame the best way to improve the solution based on participants' subjective experiences, as well as their objective actions;

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[6] Loc. 379 of the e-book

- it is *theoretically transformative*, as it strives to arrive at results that are framing the designed improvements theoretically, which results in transforming theory through the interventions with practice.

Figure 3 illustrates how the learning experience is created from factors related to both learner needs and the learning technology: when human meets technology. The present study is grounded in the assumption that the design of learning technology is most likely to be successful when self-regulated learning (SRL) is supported and facilitated by the design (cf. Azevedo, 2005; Azevedo & Aleven, 2013; LeFrere, 2005).
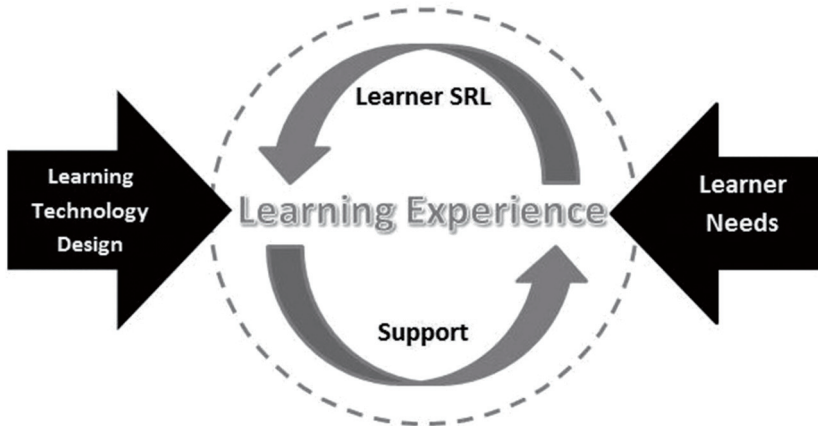
Figure 3 Designing learning experiences for SRL from a needs perspective.

Hoadley (2007) defines the goals of e-learning as "producing and evaluating interventions using technology that lead to student learning outcomes in particular applications". Not surprisingly, most studies on e-learning have been concerned with the effectiveness and benefits of various e-learning solutions compared to traditional learning. Less research has been focused on the actual experiences of learners (Davis & Wong, 2007).

This study is, however, exploring end-users' e-learning experience and is hence concerned with the psychological aspects of using e-learning for the purpose of learning. Hence, I am not interested in quantification of participants' learning, but instead, how they learn, as well as their experiences in the learning process towards achieving some kind of learning outcome. From this perspective of targeting e-learners' experiences in a new learning context, the design of the context is seen as a facilitative and mediative factor for SRL and the appropriating process of the new learning tool. The concept of context is, however, multi-layered and complex, and will be discussed in the following.

Learning spaces and time dimensions

Illeris (2007) claims that learning is dichotomous, including both an individual process and a socially situated process. In several theories of SRL (the third pillar of this study),

learning is assumed to be reciprocally dependent on the context (Bandura, 1986; Pintrich, 2005; Zimmerman, 2005). According to the framework of Pintrich (2005), context is one of the four areas of the dynamics of SRL. However, context is not a single factor, but a number of dynamic factors in itself. This can also be referred to as a whole activity system (Goodyear & Ellis, 2010; Jonassen, 2000). A self-paced e-learning course is also situated in a social context, although the learner is alone during the time of study. I would like to describe the e-learner's total learning context[7] as several interconnected learning spaces: the computer-based space, the physical space, and the extended social space (Figure 4). These three learning spaces are external contextual factors affecting the dynamics of the learning process. The computer-based space can further be divided into hardware, software, and interface. In addition to this, the digital interface displays both the instructional design of the e-learning environment, as well as the course content to be learned. The learner has to be able to manage all these dimensions of the computer-based space in order to be successful.
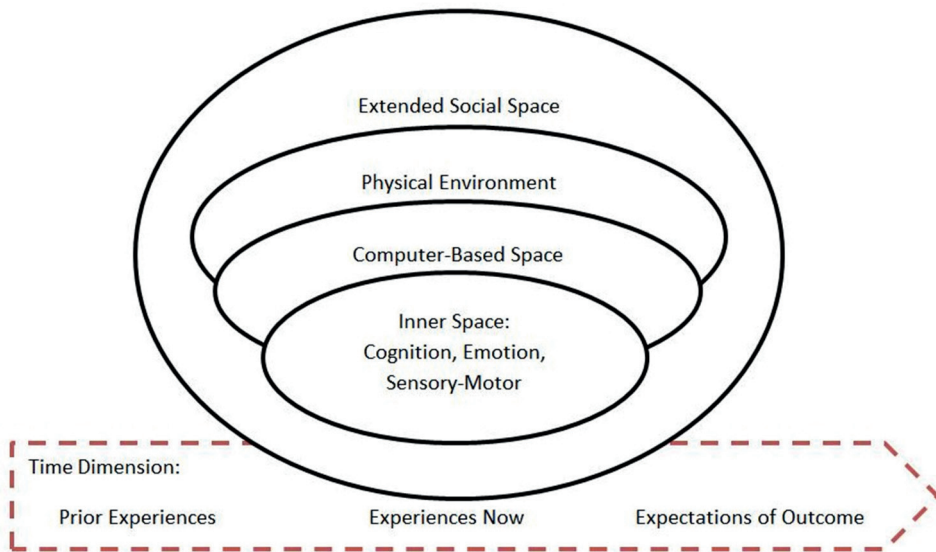
Figure 4   Layers of learning spaces and time dimensions.

Furthermore, there is the physical space of the room in which the learning takes place. This can be anywhere, anytime, and anyhow, and therefore may include an infinite number of influencing factors. The extended social space may also influence the learning

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[7] I use the term environment synonymously to context.

situation, as this refers to the work situation or life situation of the learner, i.e., the social networks the learner is a part of (cf. Bronfenbrenner[8], 1994).

In addition to the contextual learning spaces, there are also various dimensions of an individual's inner space for learning. These can be divided into cognitive, emotional, and sensory-motor dimensions (cf. areas of SRL by Pintrich, 2005). Our cognition concerns our ways of processing information, while regulation of emotions and affect in relation to the content is an essential part of how a learner makes decisions for learning (Damásio, 1994; Deci & Ryan, 2000; Nahl, 2006; Pintrich, 2005). The sensory-motor, or physiological dimension, has to do with our bodily adaptability to the spaces. For instance, how our fingers fit the keyboard, or how the context is suitable for our senses, such as audio, visuals, etc. (Dix et al., 1997; Stewart, 2008).

While exploring the subjective experiences of individuals using technological artefacts, there are also factors related to the time dimension that may impact the situation. Roughly, these can be divided into three categories: prior experiences, experiences in the now, and expectations of future experiences or outcomes (Hassenzahl, 2010). In that regard, the time dimension can be described as being interconnected with the learning spaces. Figure 4 illustrates how various learning spaces and time, described in the text above, are interrelated and cannot be separated from the learning experience. In this study it is assumed that how a learner is self-regulated is dependent on the dynamics of these factors. Nahl (2012, p. 171) claims that people's "actions, evaluations, engagement intentions, and plans develop organically, as part of their personal adjustment to the social computing situation, thus technology, biology, and social practices are fused in an interactive synergy."

This study is influenced by several scientific fields, including HCI and instructional design of e-learning content and contexts, as well as user experience research as the end-user is the subject of study with regard to both learning and managing the context. My questions in this research study relate to Matthew Moore's question about whether e-learning needs to be more focused on the learning experience. What are the factors affecting the experience; for instance, providing enough engagement to keep us awake? Furthermore, how are these factors of the experience related to our learning process? And how can we design e-learning solutions for targeting specific learner needs in order to facilitate a good learning experience and user satisfaction, as well as reaching the intended learning goals? The overlap of learning research and HCI research is illustrated in Figure 5 below. The *user experience* (HCI research) represents the hedonic aspects related to affect, while the *learning outcome* (learning research) represents the cognitive achievement in relation to the goal of the learning solution. The assumption is that a positive user experience facilitates a better learning outcome. The triggers are both external and internal. The *external triggers* are found in the learning context; for

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[8] Bronfenbrenner argues that we have to look at all the ecological systems a person is part of in order to understand his/her development.

instance, how the instructions and the interface are designed to engage and activate the learner. The *internal triggers* involve the learner's own self-regulation; for instance, how he/she regulates motivation for learning.
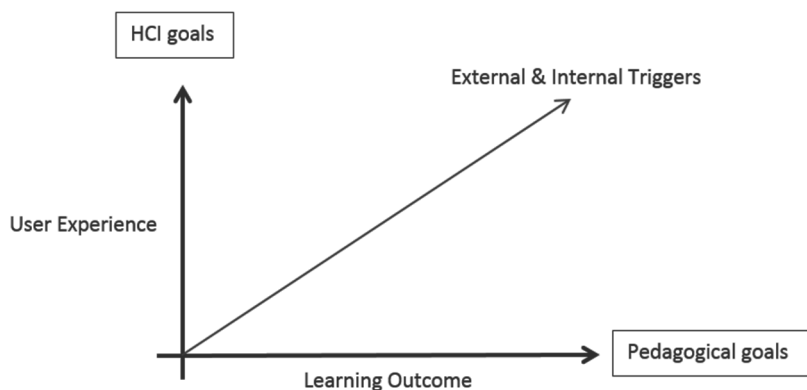
Figure 5 The connection between a positive learning experience and outcome.

The empirical study targets novice e-learners' SRL with specific focus on actions and intentions for managing an e-learning environment that is new to them. The learning environment will not be analysed as such, only described in terms of the difference between the iterations. It will further be discussed through the lens of SRL and how the learners' cognitions, emotions, and actions are affected by the environment.

4 Self-regulated learning (SRL)

As stated in Chapter 1, the aim of the study is to investigate how corporate e-learners actions and intentions are influenced by the design of a self-paced e-learning course. Figure 1 illustrated how the contribution of the present study is to give insight into the intersection between self-regulated learning (SRL), learning technology design, and the field of educational design research. The concept of SRL is at the core of the theoretical frame of reference, and hence, the third pillar of this research study. The content of this chapter emanates from looking at SRL from a "rear view mirror" perspective (cf. McLuhan, 1964): comparing prior theories of SRL, including studies targeting SRL in e-learning environments. To provide a complete review of the vast amount of research and theories of SRL would be nearly impossible. However, I will clarify important concepts and terminology in order to frame the theoretical background and the aim of this study.

4.1 Theoretical perspectives

McKeachie (2005) gives a short description of the evolution of learning research in his foreword in the Handbook of Self-Regulation, starting with behaviourism in the 1950s and 1960s, and its contradictions which gave rise to cognitivism. The emergence of the concept of metacognition[9], when scientists began to discuss knowing about knowing, led researchers into the field of affect, motivation and goals. This is the time when the concept of self became a major theme. Theories of self-regulation are a continuation of this long evolution of learning research. These theories are more or less a synthesis of earlier theories of learning integrating cognition, motivation, learning behaviour, as well as social aspects of learning.

McKeachie is somewhat hesitant to say that theories of self-regulation are the final answer to learning research. Furthermore, with the new era of digital online learning environments we might need to redefine the concept of self-regulated practices - at least regarding overt (open and visible) expressions, but perhaps also expressions of covert (hidden) self-regulation for learning. This new era further impacts how we can explore and measure self-regulation using new technology, for instance for tracing learner actions and reflections (Azevedo, Moos, Johnson & Chauncey, 2010a), which the digital evolution provides new opportunities for (Aleven, Roll, McLaren & Koedinger, 2010).

Defining self-regulated learning

As mentioned in Chapter 1, SRL is referred to as learners' ability to exercise agency while learning (cf. Azevedo & Aleven, 2013). It concerns expressing confidence, diligence, and resourcefulness in learning situations (Zimmerman, 1990). One confusion in the

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[9] The term metacognition will be discussed more thoroughly in the section on areas of SRL.

terminology can be found in how authors use the concepts of self-direction and self-regulation, especially in the literature on adult learning and workplace learning. Theorists claim that our learning is dependent on both self-direction (Tobin, 2000) and self-regulation (Weinstein et al., 2005). Although these aspects of learning can be seen as an interrelated part of the learning process as such, a distinction between them can be made (Brand-Gruwel et al., 2014; Kerlin, 1992). I emphasize this distinction in a pragmatic way related to the present study. I would like to define self-direction as one's own learning independence in relation to instructional forces: choosing where to go and the methods to reach the destination (cf. Tobin, 2000; Hamlett, 2006), whereas self-regulation is about mastering one's skills in the actual learning process so that one succeeds in the task that one has chosen to undertake (cf. Azevedo & Aleven, 2013; Brand-Gruwel et al., 2014; Weinstein et al., 2005). In that sense, self-direction concerns our independence in choice of content in relation to instruction and goals, while self-regulation refers to our ability to adapt to the tasks and context in order to master the learning process. For this purpose, Weinstein (1994) highlights the importance of being in charge of our skill, will and self-regulation[10]. Dettori (2013) wants to demystify the notion of self-regulated learning by distilling it to three factors: awareness, strategic action, and motivation.

According to Pintrich (2005), there are at least four assumptions about learning and regulation of learning that are present in most models of SRL. The first has to do with learners actively constructing their own learning. Secondly, it is assumed that learners are able to control and monitor their learning with regard to cognition, emotion, behaviour, as well as context. The third assumption is based on learners being able to set goals for themselves and regulate their learning in accordance with set standards or criteria. The final and fourth assumption is that a learner's self-regulating activities (including their regulation of cognition, emotion, and behaviour) function as mediators for the person and the context, and consequently the learning outcome (Pintrich, 2005). He includes these four general assumptions inherent in the models of SRL, in his working definition of SRL as:

> […] an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment (Pintrich, 2005, p. 453).

Boekaerts (1996) agrees with the cognitive focus, but includes both context and well-being in her definition describing SRL as:

> […] the capacity (1) to exert control over different dimensions of the learning process, including the selection, combination, and coordination of cognitive strategies in a context-sensitive way, and (2) to allocate resources to the different aspects of the learning process, without too much distortion of well-being (Boekaerts, 1996, p. 102).

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[10] Weinstein also refers to self-regulation as self-governance.

Boekaerts deviates from Pintrich's definition in adding well-being goals as a competing factor to academic learning goals. However, both Pintrich and Boekaerts highlight the importance of adapting to contextual features and being context-sensitive. The assumption of this study is that this is even more important when the learning context is totally new and different from what the learner has experienced before, as in the case of being confronted with an e-learning environment for the first time.

Zimmerman (2005, p. 14) defines SRL as "the self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals". He agrees with Pintrich by approaching SRL from the perspective of thoughts, feelings, and actions. He also agrees on the importance of planning and goals as overriding features guiding the regulation of the learning process. Zimmerman adds another aspect in his definition of SRL, as he describes it as a cyclical process, and he is not alone in this regard (cf. Greene & Azevedo, 2009; Pintrich, 2005; Winne & Perry, 2005). The cyclical phases of SRL will be discussed more thoroughly in relation to models and processes of SRL.

An atheoretical framework of SRL

The terminology related to self-regulated learning is rather vast, including overlapping concepts (e.g., metacognition, volition, planning). The diversity in theoretical background (Zimmerman, 1994) and methodological approaches (Cordingley, Lai, Pemberton, Smith & Volet, 1998; Winne & Perry, 2005) of researchers is one reason for this inconsistency. When it comes to studying learning, a researcher's personal, ontological and epistemological orientation towards the subject will influence what the targets of research are, as well as how the research is conducted. As a solution for obtaining an overview of SRL, and disregarding the theoretical ties, Zimmerman (1994) proposes an atheoretical framework for identifying key dimensions of SRL; i.e., the perspectives that remain when the theoretical veil is lifted. His framework is categorised according to the scientifically posed questions of why, how, what, and where. These questions are fundamental to our understanding of human learning, and they represent key psychological dimensions of how we can study SRL (Zimmerman, 1994; Pintrich, 2005).

Why we act in a certain way reveals our motive for learning and involves our self-goals, self-efficacy, values, attributes as the self-regulatory process. The why-perspective has been of interest for phenomenologists, such as McCombs (1989) and attributional theorists, such as Dweck (1986), and Nicholls (1978). It has also been explored by motivational theorists such as Deci and Ryan (2000), who studied learners' perceived locus of causality in relation to our self-regulation.

How we act in a learning situation concerns our methods of regulating our learning, i.e., our application of learning strategies. This has been of interest for researchers focusing on metacognition, such as Borkowski (1996) and Weinstein (1994). The prefix 'meta' is a Greek word used in the meaning of the concept 'about' itself. Cognition about our

cognition relates to our awareness of our cognition, and consequently how we act on this awareness. The how perspective has also been researched by those with a Vygotskian theory perspective, such as Rohrkemper (1989), who focused on adaptive learning, and defined it as "the ability to take charge of frustration and maintain the intention to learn while enacting effective task strategies in the face of uncertainty - taking charge of one's motivation, emotion, and thinking" (Rohrkemper, 1989, p. 143); in other words, how we act and adapt in order to maximize our success in learning.

What has to do with the object of learning; the learning outcome involving the whole process as such (Marton & Säljö, 1976; Marton and Booth, 1997). What we learn includes SRL processes of self-monitoring, self-judgement, action control, and volition. Here, Zimmerman (1994) mentions volitional theorists, such as Corno, and Heckhausen, and researchers of metacognition, such as Flavell, as having rather contrasting views on SRL processes.

Where, or with whom we learn, deals with how we manage our environment, as well as social relations in relation to learning. This includes, for instance, environmental structuring and help seeking behaviour. Social cognitive theorists, such as Schunk (1989) and Zimmerman (1989), have investigated social models, while constructivists, such as Paris and Byrnes (1989), have explored learners' own construction of supportive environments (Zimmerman, 1994). Recently, socio-cultural theorists have expanded the social dimension of regulation of learning to include co-regulation, which is described as "individuals' various attempts to affect each other's motivation, emotional state, cognitive actions etc. for the purpose or others' benefits, or alternatively to co-ordinate their actions for a shared purpose". In addition to co-regulation, they further describe socially shared regulation, which is "a special case of co-regulation, where several individuals regulate their collective activity in a genuinely shared way" (Järvenoja, Volet & Järvelä, 2013, p. 35). Regulation of collective adult online learning has been explored by, for instance, Susimetsä (2006), while Järvelä, Näykki, Laru and Luokkanen (2007) have investigated the regulation of collaborative mobile learning in higher education.

Learning strategies and SRL

In order to master the learning process and manage our learning, we need to know what actions to take; what strategies are most likely to bring success. The concept of learning strategies is one important term in describing SRL. In fact, definitions of learning strategies are many times overlapping the definitions of SRL. Weinstein et al. (2005, p. 733) give a broad definition of learning strategies: "[…] any thoughts, behaviours, beliefs, or emotions that facilitate the acquisition, understanding, or later transfer of new knowledge and skills." Based on this definition, we can assume that we could separate learning strategies into categories representing cognitive, behavioural, motivational, and emotional strategies. These strategies represent how we are able to regulate our learning. They further describe learning strategies as "tools used in the service of goals", and they emphasize that a learner's goal- and motivational orientation determines how and

whether learning strategies are used (ibid, p. 741). This relates well to Pintrich's definition that defines SRL as guided and constrained by goals.

Tessmer and Jonassen (1988) claim learning strategies to be learner-controlled methods, which are used for processing and recalling information derived from instruction and instructional materials. The word control is used from the perspective of the learner being self-regulated. Control is also a keyword used to describe SRL (Pintrich, 2005), as it involves the ability to regulate something. Harnishfeger and Bjorklund (1990, p. 1) define strategies as "goal-directed operations employed to facilitate task performance", which is similar to how Pressley, Borkowski, and Schneider (1987, p. 90) describe learning strategies as: "operations beyond the processes that are a natural consequence of doing a task".

Learning strategies are, as seen in the definitions above, described in many ways: as tools, learner-controlled methods, goal-directed operations, etc. The definitions further suggest that learning strategies are used for processing information, facilitating task performance, and achieving goals. Shortly, we could explore learning strategies by asking two questions: how does one take actions for learning, and why does one take actions for learning? The how-question reveals the strategies used, while the why-question reveals the intentions behind these strategies. In that sense, strategies are both activities and motivations.

There are a number of various ways in which researchers have categorised learning strategies, depending on the perspective they have. Randi and Corno (2005) separate covert and overt strategies. Covert refers to internally focused strategies to control learning situations, such as metacognition, motivation, and emotion. Overt strategies are the visible activities used for controlling learning, such as control of the task situation and resources, and controlling others by, for instance, asking for help (cf., Zimmerman, 2005). The concepts used in the first definition above (Weinstein et al., 2005, p. 733), can be categorised according to Randi and Corno's typology. As such, thoughts, beliefs, and emotions represent covert strategies, while behaviours represent overt strategies.

Some researchers separate motivation from learning strategies in the investigation of self-regulated learning (e.g., Pintrich, Smith, Garcia & McKeachie, 1991; Ruohotie, 2000; 2002). Here, the motivation category involves the whole process of planning and goal-setting, and also the beliefs that affect our learning and motivation for learning. The category of learning strategies has both overt and covert expressions, including invisible cognitive and metacognitive strategies, as well as visible learner actions, such as note taking. Tessmer and Jonassen (1988) categorise learning strategies into primary strategies and support strategies based on how they function to control the learning process. Primary strategies work directly with the information to be learned and have to do with our cognition. Support strategies are aimed at improving general cognitive functioning, and involve our self-regulation for learning. In that sense, they separate

self-regulation from the information processing, while others seem to use the concept of self-regulated learning strategies for all learner actions (cf. Zimmerman, 1989).

Let us assume that learning strategies simply are actions for learning, and that self-regulated learning involves actions for learning that the learner him- or herself regulates, whether these are visible to an observer or not, and whether these are used for information processing or for controlling the environment. SRL involves how we strategically monitor and control our learning intrinsically, as well as how we regulate extrinsic conditions for learning. Hence, categories of learning strategies describe how learners regulate their learning in various ways by using a variety of actions for learning – both overt and covert. Learning strategies are, thus, of interest to the present research study. However, I remain open-minded as to how the context of e-learning may have impact on how various strategies can be defined as self-regulatory or not.

Knowledge about learning strategies: According to Weinstein and her colleagues (2005), there are three levels of knowledge about learning strategies. Declarative knowledge indicates what actions (overt or covert) learning strategies represent. Procedural knowledge indicates how to use certain strategies for best results, i.e., how to maximize the effectiveness and efficiency of a chosen strategy. Conditional knowledge indicates when a certain strategy is applicable in a learning situation. Shortly, a strategic learner could be described as one who possesses these three levels of knowledge about learning strategies, and, hence, knows what measures need to be taken in order to learn something in a specific situation and environment. In other words, knowledge about learning strategies is important for learners' ability to exercise agency over their learning process (cf. Azevedo & Aleven, 2013). In order to clarify these three concepts, I will relate them to the context of the chosen e-learning course subjected to study. Firstly, the learner needs to know what kinds of strategies are available within the e-learning course (declarative knowledge about learning strategies). For instance, he knows that he can check his level of knowledge by taking the practice questions after each course module. Secondly, the learner needs to know how to use a strategy effectively and efficiently (procedural knowledge). For instance, he knows how he can jump between the practice questions and the module content in order to find his gaps of knowledge. That is, he adapts the strategy according to his own needs in the moment. Thirdly, the learner needs to know when he can use a certain strategy (conditional knowledge). For instance, he knows that it is too late to go back to the practice questions to find his gaps of knowledge after he has started the timed final test.

Learning strategies versus learning styles: Another clarification to make regarding terminology is the difference between learning strategies and learning styles. While learning strategies can be described as sequences of actions in order to achieve learning (King, 1996; Schmeck, 1988), learning styles can be described as learners' predispositions to use certain strategies (Curry, 1983; Das, 1988; King, 1996). The difference lies in comparing actions (strategies) with preferences (styles) (Menges & Austin, 2001; Olgren, 1996; Olgren, 2000; cf. Riding & Rayner, 1998). This thesis focuses

on SRL, which involves learning strategies as learner actions (covert or overt) and choices made in a learning situation; in other words, how we strategically regulate ourselves, the task, and the context in order to learn. However, part of SRL is also our awareness of our preferences for learning and how we adapt our preferences to the requirements and conditions of a specific learning situation; its affordances and constraints. Therefore, one could say that SRL encompasses both strategies and styles of learning, although not in categorising styles as such, but rather discussing learners' awareness of and ability to adapt and control their preferences for learning. It is similar to what McKeachie (1995) claims as our ability to turn learning styles into learning strategies, which, again, relates back to developing the three levels of knowledge about learning strategies; i.e., knowing what they are, and how they are used best under different circumstance (Weinstein, et al., 2005).

4.2 SRL as a dynamic process

One way to describe SRL is to see it as a dynamic process. A model of SRL is a way to illustrate how the dynamics of SRL can be described as a process of a limited number of factors and determinants, or areas and phases. Depending on the perspectives of theorists, various factors are emphasized in the models illustrating SRL-processes. In the following, I will discuss the SRL model of Zimmerman in detail, and compare it briefly to two other models, i.e., Boekaerts' model, and Winne and Hadwin's model. These models are based on SRL research in traditional learning contexts. Efklides' model illustrates the interactions of metacognition and affect in SRL. Azevedo and his colleagues have adapted traditional SRL models to computer-based learning environments. Their research will therefore be scrutinized with regard to SRL for learning technologies. The framework of SRL in Table 2, outlined by Pintrich (2005), can also be seen as a model (Puustinen & Pulkkinen, 2001), as he depicts it as a process of four phases.

4.2.1 Zimmerman's triadic reciprocal causation model

A social cognitive theory of learning was presented by Bandura (1986) and later reworked by Zimmerman (1989). Bandura (1986; 1997) uses the term "causation" to describe functional dependence. He illustrates the triadic reciprocal causation and its relationship between the three major classes of determinants in a learning situation: personal factors (cognitive, affective, and biological), behaviour, and the external environment. In Zimmerman's model, self-regulation is, similarly to Bandura's perspective, seen as a triadic process, in which there is an interaction between personal, behavioural, and environmental factors. However, Zimmerman developed Bandura's model of triadic reciprocal causation further, and added a loop of covert self-regulation; the 'under cover' regulation that goes on without any visual manifestation (see Figure 6).
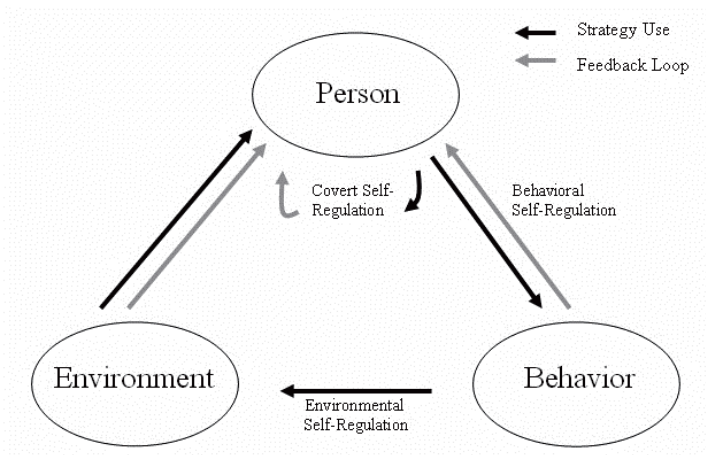
Figure 6 Model of triadic forms of SRL (adapted from Zimmerman, 2005, p. 15)[11].

The factors are constantly changing within a learning situation. Therefore, it is necessary to continuously monitor progress through three self-oriented feedback loops: *behavioural self-regulation* (strategically adjusting study tactics based on self-observation), *environmental self-regulation* (adjustment of environmental factors or outcome), and *covert self-regulation* (adjusting and monitoring cognitive and affective states). The first two, behavioural and environmental self-regulation, are both overt expressions (cf. overt learning strategies by Randi and Corno, 2005). Thus, self-regulation is about continuously adjusting one's choice of strategies and goals (Zimmerman, 2005).

Cyclical phases

Another important aspect Zimmerman wants to highlight is that self-regulation is "cyclical because the feedback from prior performance is used to make adjustments during current efforts" (Zimmerman, 2005, p. 14). Similarly to Pintrich, he describes three sub-processes of self-regulation as *forethought, performance or volitional control*, and *self-reflection* (Figure 7), though Pintrich (2005) further divides the second phase into monitoring and control.

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[11] © 1989 by American Psychological Association.
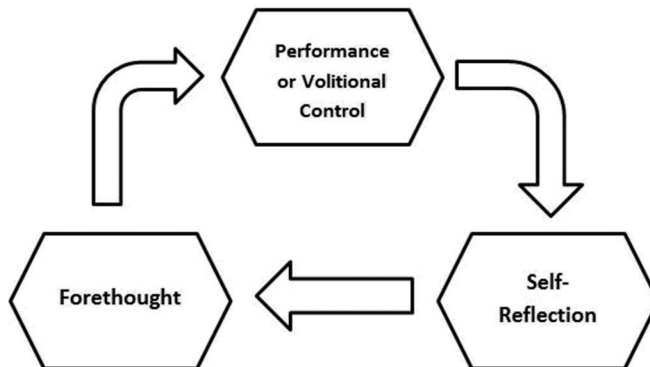
Figure 7   Phases of SRL (adapted from Zimmerman, 2005, p. 16)[12].

In the forethought process, we do a task analysis of the learning situation, where we set goals for ourselves and plan tasks strategically. Another important aspect is our self-motivation beliefs. These include self-efficacy, expectations of outcome, intrinsic interest in the task, as well as goal orientation. The forethought process precedes efforts to act, and sets the frame for our approach towards the learning task. The second sub-process, performance or volitional control, is about our ability to exercise self-control and self-observation. It is what we do during the motoric efforts within a learning situation. Our self-control in learning is our ability to self-instruct, the use of imagery, how to focus attention, and the strategies developed for completing a task. We can develop self-observation through self-recording and experimentation. The third sub-process, self-reflection, has to do with self-judgement and self-reaction, i.e. our response to a learning experience. The first response is how we judge and evaluate our abilities and input, and what kind of attribution we project on the learning outcome. The second response is about satisfaction with the work, where we can either react adaptively and develop refined strategies for better performance, or react defensively for self-protection and hence limit personal growth. According to these three sub-processes, self-regulation in learning is the process of what we think about (or intuitively react to) the learning situation and our actions in the process before, during and after.

Zimmerman (1989) claims there are three advantages to investigating self-regulated academic learning from a social cognitive perspective. Firstly, it distinguishes the effects of personal (self-) regulatory influences from overt behavioural ones and can explain the relative advantage of each. Secondly, it links our self-regulatory processes to specific social learning or behaviourally enactive experiences and can explain their reciprocal impact. Thirdly, it identifies two key processes through which self-regulated learning is achieved: self-efficacy perceptions and strategy use, and can explain their relation to our

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[12] © 1998 by Guildford Press.

motivation and academic achievement. However, Zimmerman (1989) also claims that "in comparison with purely cognitive approaches, a social cognitive view is more restrictive insofar as it does not focus on mental phenomena unless they are manifested overtly in some form during social and behavioral functioning." I am investigating all cognitive and affective processes conscious to the learner, whether they are manifested overtly or not. However the aim of the study, as such, places much emphasis on cognition and affect in relation to the external factors for learning. My interpretation is that, in one way or another, the cognitive and affective processes are related to the experiences of the learner within the learning environment. However, I do not see it as necessary to restrict my view to only focusing on that which has an overt expression. Such a focus would limit the possibilities of illuminating the full picture of the e-learning experience, which is the attempt in this study.

4.2.2 Boekaerts' model emphasizing goals

In comparison to Zimmerman's focus on the overt expressions for learning, Boekaerts' model of SRL is leaning more towards the inner world of the learner. SRL is seen as a process stemming from identification and interpretation, as well as from the learner evaluating opportunities to learn. Goal-orientation is emphasized as an overriding feature. SRL is seen as a generic term for several phenomena. It is described as "a system concept that refers to the overall management of one's behaviour through interactive processes between these different control systems (attention, metacognition, motivation, emotion, action, and volitional control)" (Boekaerts & Niemivirta, 2005, p. 417-450). The model considers interactions between motivation, affect, and metacognition. However, according to Efklides' (2011, p. 9) interpretation of Boekaerts' views on affect, it is rather regarded as "a threat to the self and coping to maintain one's well-being rather than as an indispensable component of any cognitive processing".

This focus on well-being is the distinguishing characteristic found in Boekaerts' model. "Finding a balance between learning goals and ego-protective goals" is seen as a driving force, an academic growth pathway versus a well-being pathway (Boekaerts & Niemivirta, 2005, p. 417-450). It represents a wider view on motives for learning, where the academic motive always runs parallel to a more personal motive of well-being (Puustinen & Pulkkinen, 2001). The academic growth pathway directs the learner towards learning, while the drive of the well-being pathway is to ensure emotional stability by avoiding negative emotions. Based on this duality, the implication for learning is that it is assumed to be facilitated whenever the learner can define his/her own goals and learning episodes. From a design perspective, this highlights the importance of minimizing constraints that elicit negative emotions, while providing affordances that facilitate goal-setting and planning.

4.2.3　Winne & Hadwin's model of COPES-processes

The Winne and Hadwin model of SRL (Winne & Perry, 2005) identifies four phases of the SRL process: task definition, goal setting and planning, studying tactics, and adaptations to metacognition (see Figure 8). What differs in their model, compared to the models discussed earlier, is that they claim that each of the four phases can be divided into five processes in itself, i.e., conditions, operations, products, evaluations, and standards (used as the acronym COPES). Their contribution to the SRL theoretical work is, thus, that they have provided a more elaborate description of the SRL phases.
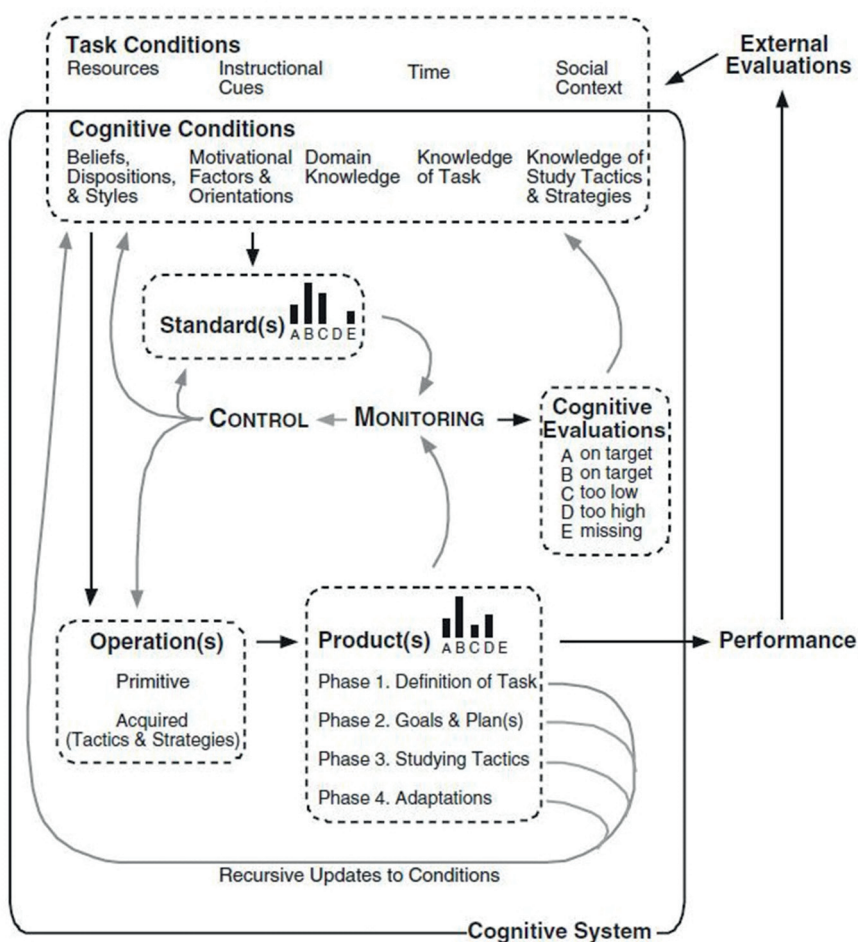
Figure 8 Winne and Hadwin's model (adapted from Winne & Perry, 2005, p. 537)[13].

The two areas of motivation/affect and context are included in what Winne and Hadwin (1998) describe as conditions. Task conditions are contextual resources, instructional

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[13] © 1998 by Lawrence Erlbaum Associates.

cues, time, and the social context. The cognitive conditions involve beliefs, dispositions, and styles, as well as motivational factors and orientation. It also includes learners' knowledge about the task, and knowledge about study tactics and strategies. Standards involve metrics of what is to be learned and how it is measured, and learners' beliefs about the task and its difficulty, which ultimately relates to their goal-setting for the task. Operations involve information processing. These processes are described as the acronym SMART (Searching, Monitoring, Assembling, Rehearsing, and Translating) and are not metacognitive, as they simply result in cognitive products (Winne & Perry, 2005). This is where the four phases of SRL come in. The products are compared with the set standards through monitoring and control, and cognitive evaluations. Thus, the processes of products and standards impact the phases of SRL. Finally, after recursive processes of conditions, standards, operations, and products, there is the outcome of the performance leading to external evaluations.

According to Greene and Azevedo (2007, p. 338), the SRL model of Winne and Hadwin has at least three contributions to our understanding of SRL. Firstly, the cognitive system, or architecture, is made up of phases that all include similar processes: "This architecture explicitly models how the work of the phase is done and allows for a more detailed look at how various aspects of the COPES architecture interact". Secondly, the model shows in detail how SRL is recursive. The key to this is the monitoring and control in each of the phases, by which changes in one phase may determine changes in another. Thirdly, task definition is described as a separate phase from goal setting, hence, defining them as different phenomena.

4.2.4 Azevedo's CAM model of hypermedia learning

Azevedo's CAM model stems from his and his many colleagues' work on a multi-agent hypermedia learning system called MetaTutor (Azevedo et al., 2010b; Azevedo et al., 2011). The CAM model describes how learners apply and use cognitive, affective and metacognitive (CAM) processes. The CAM model is strongly focusing on the person-in-context perspective and is based on five assumptions. In order to be successful, learners need to:

- Monitor and control key CAM processes; that is, regulate them
- Adapt to context-specific requirements
- Have the ability to monitor and control both internal and external factors
- Make adaptive, real-time adjustments to internal and external conditions, based on accurate judgments of the utilized CAM processes
- Be able to activate certain CAM processes (e.g., interest, self-efficacy, task value) in order to become motivated to utilize other appropriate CAM processes for learning.

In other words, SRL is context-dependent adaptability for which a learner's intentions and affective state influences how the learner chooses actions for learning. One key is

the learner's ability to make metacognitive judgements about how choices of learner actions are working and not working in a specific context. Azevedo's research group combined several of the SRL models to fit this new context of hypermedia learning. The CAM model is based on the model of Winne and Hadwin, as well as on those of Pintrich and Zimmerman (Greene & Azevedo, 2009) and describes, as do many of the other models discussed, SRL as a process. Azevedo's CAM model of hypermedia learning is distinct in how it separates macro-level processes of SRL from micro-level processes in a hierarchical manner. The macro-level processes are similar to phases described in other models (cf. Pintrich, 2005; Zimmerman, 2005). In relation to these macro-level processes, Azevedo and his colleagues have more than 30 specific self-regulatory activities, which they call micro-level SRL processes. However, the focus is placed on cognition and metacognition. Table 1 below lists both levels of processes.

Table 1 Azevedo's categorisation of SRL processes

Macro-level SRL processes	Micro-level SRL processes
A. Planning	1. Prior knowledge activation
	2. Recycle goal in working memory
	3. Sub-goals
	4. Planning
B. Monitoring	5. Judgement of learning (JOL)
	6. Feeling of knowing (FOK)
	7. Self-questioning
	8. Content evaluation
	9. Identifying adequacy of information
	10. Monitoring progress toward goals
C. Strategy use	11. Finding location in environment
	12. Goal-directed search
	13. Evaluating content as answer to goal
	14. Mnemonics
	15. Reading notes
	16. Coordinating informational sources
	17. Taking notes
	18. Re-reading
	19. Selecting new informational sources
	20. Free search
	21. Summarization
	22. Inferences
	23. Drawing
	24. Hypothesizing
	25. Knowledge elaboration
	26. Read new paragraph
	27. Memorisation
D. Task difficulty and demands	28. Help seeking behaviour
	29. Control of context
	30. Expect adequacy of information
	31. Time and effort planning
	32. Task difficulty
E. Interest	33. Interest statement

The approach to measure and aggregate data from both macro- and micro-level processes could, potentially, be a beneficial way of comparing successful learners from non-successful learners, and using this understanding for the design of hypermedia learning environments that support learners SRL processes (Greene, Dellinger, Binbasaran Tuysuzoglu & Costa, 2013). Azevedo and his colleagues (Azevedo, Cromley & Seibert, 2004; Greene & Azevedo, 2009; Azevedo et al., 2010b; Azevedo et al., 2011) are specifically researching hypermedia learning contexts of complex topics. The model also includes a tutor and scaffolding perspective. They suggest that "developers of hypermedia environments may want to look at the micro-level for clues regarding what specific SRL processes are associated with learning particular topics, and then build in computerized tutors or scaffolds that target those specific processes" (Greene & Azevedo, 2009, p. 25). They also argue that epistemic beliefs, i.e., learners' beliefs about what knowledge and knowing actually is, must be studied.

4.2.5 Efklides' model of metacognition and affect in SRL

Efklides' (2011) Metacognitive Affective Model of SRL (MASRL; Figure 9) distinguishes between two levels of processes: a top-down process derived from goals based on general personal characteristics, and a bottom-up process of self-regulation based on data-driven micro-level monitoring processes in the moment (cf. Greene & Azevedo, 2009 on micro-level SRL processes).
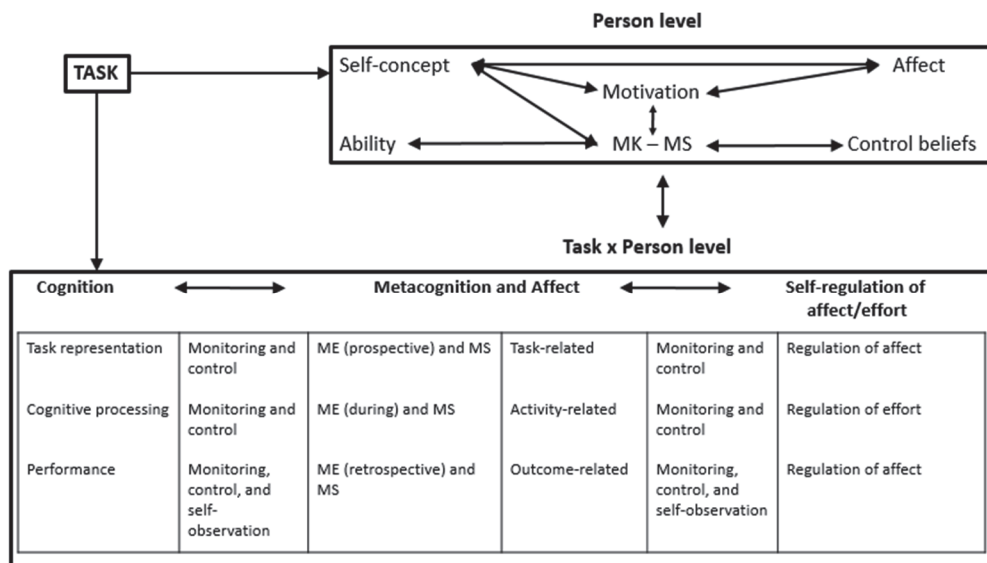
ME = metacognitive experience, MK = metacognitive knowledge, MS = metacognitive skills

Figure 9 The MASRL model (adapted from Efklides, 2011, p. 7)[14].

What Efklides claims to be the added value of her MASRL-model, is the fact that the model "offers a theoretical integration of two largely unrelated lines of research, namely, metacognition and motivation/affect" (ibid, 2011, p. 7). Her thesis is based on the notion that learners' subjective experiences are both metacognition and affect. These subjective experiences are keys to self-regulation and represent the top-down process (Person Level in Figure 9). The top-down process can be reversed to bottom-up processes (Task x Person Level in Figure 9), or vice versa, through metacognitive and affective experiences.

4.3   Areas of SRL

While the text above was an attempt to define self-regulated learning (SRL) and briefly describe a few models, I will now discuss areas of SRL: cognition, motivation and affect, behaviour, and context. This outline of the areas of SRL is grounded in the work of Paul Pintrich. A major contribution of Pintrich is his general framework for SRL as "a heuristic to organize our thinking and research on self-regulated learning" (Pintrich, 2005, p. 455). He combines the areas and the phases in a matrix illustrating SRL (see Table 2). Although Pintrich's framework is structured in a time-ordered sequence, it does not imply that this is always the case in a learning situation. He is rather suggesting that the four phases, 1) forethought, planning, and activation, 2) monitoring, 3) control, as well as 4) reaction and reflection, is a dynamic process in itself. The framework is, besides these four phases, divided into areas of cognition, motivation and affect, behaviour, and context. The first three represent the traditional way of differentiating areas of psychological functioning, but are in many ways difficult to differentiate (Pintrich, 2005; Snow, Corno & Jackson, 1996).

Pintrich depicts self-regulation as a cross-sectional phenomenon across both areas and phases, while others (Tessmer & Jonassen, 1988; Weinstein, 1994) outline it more as a separate phenomenon. He lists each phase separately by describing how these are represented by specific approaches and strategies in relation to the four areas of SRL, or rather how and why we take actions in a learning situation. In phase 1 we plan and set goals for a task, but we also activate prior knowledge about both content and context related to the task, and especially our own relationship to it. Phase 2 involves our monitoring of the task, which is closely linked to our metacognitive awareness of our own learning, our emotional regulation abilities, effort regulation, as well as our abilities to monitor and change the environment. While the second phase involved the metacognitive awareness of our regulation in the areas, phase 3 concerns how we actually regulate and control our learning with regard to the four areas (cognition, motivation and affect, behaviour, and context). Phase 4 is the end of the process where we reflect on the learning, ourselves, and the context based on our reactions and attributions induced by the task (Pintrich, 2005; cf. Zimmerman, 2005).

Table 2 Framework of SRL (adapted from Pintrich, 2005, p. 454)

Areas of SRL / Phases	Cognition	Motivation/Affect	Behaviour	Context
1. Forethought, planning, and activation	Target goal setting Prior content knowledge activation Metacognitive knowledge activation	Goal orientation adoption Efficacy judgements Ease of learning judgements (EOLs); perceptions of task difficulty Task value activation Interest activation	[Time and effort planning] [Planning for self-observations of behaviour]	[Perceptions of task] [Perceptions of context]
2. Monitoring	Metacognitive awareness and monitoring of cognition (FOKs, JOLs)	Awareness and monitoring of motivation and affect	Awareness and monitoring of effort, time use, need for help	Monitoring changing task and context conditions
3. Control	Selection and adaptation of cognitive strategies for learning, thinking	Selection and adaptation of strategies for managing motivation and affect	Increase or decrease effort Persist, give up	Change or renegotiate task Change or leave context
4. Reaction and reflection	Cognitive judgments Attributions	Affective reactions Attributions	Choice behaviour	Evaluation of task Evaluation of context

FOK = Feelings of Knowing; JOL = Judgement of Learning

The framework provides a frame for both the areas of SRL and the phases of the process. It is, similarly to Zimmerman's overview, attempting to outline SRL in a holistic way. In doing so, Pintrich emphasizes the areas of SRL as our cognition, motivation and affect, behaviour, and the context, and each of the four phases involve regulation of these areas. These areas are similar, but still represent a different perspective to the scientific questions of why, how, where, and what used by Zimmerman for the overview of research in SRL. For my study, both the scientific questions, as well as the areas of SRL are of interest. In the following, I will discuss the areas of SRL defined by Pintrich (2005) and relate these to studies on SRL within the context of e-learning.

4.3.1 Cognition

The word cognition originates from the Latin noun *cognitio*, which stems from the verb *cognosco*, meaning "to become acquainted with" = "to know". Hence, knowledge and thought are seen as the outcome of a cognitive process (Franchi & Bianchini, 2011, p. 4-5). Cognitive sciences are disciplines of the mind (ibid, 2011), exploring how cognitive processes unfold in our heads (Blomberg, 2011). According to Pintrich's (2005) first phase of SRL, forethought and planning, cognition is activated by our target goal setting. This goal setting functions as a standard to assess and monitor our cognitive activities against. Prior knowledge plays a critical role, but can be either consciously or automatically activated. In the latter, it is not seen as a self-regulatory activity. Other researchers emphasize the importance of a learner's epistemic beliefs for SRL. Epistemic beliefs are a person's conceptions about knowledge (Greene, Muis & Pieschl, 2010). Learning is tightly linked to our thought processes. We need to manipulate information in various ways in order to be able to store and later to retrieve it when needed. Therefore, cognition is often described as information processing (Franchi & Bianchini, 2011), and the regulation of cognition is our ability to manage this information processing: "One of the central aspects of the control and regulation of cognition is the actual selection and use of various cognitive strategies for memory, learning, reasoning, problem solving, and thinking" (Pintrich, 2005, p. 460).

Cognitive strategies

Cognitive strategies are depicted as goal-directed, intentionally invoked, as well as effortful (Weinstein et al., 2005; Weinstein & Meyer, 1991). They "are the capabilities that govern the individual's own learning, remembering, and thinking behaviour" (Gagné et al., 2005, p. 50-51). It also seems that most cognitive strategies are domain specific, and we develop them from our experiences (Tessmer & Jonassen, 1988). Already in 1968, Foster (1968, p. 3) wrote in a paper on "Categories of Cognitive Skills" that: "There are probably as many systems for classifying the different cognitive processes as there are authors writing about them". In the following I present Tessmer and Jonassen's categorisation of cognitive strategies, as these specifically target information processing strategies used for controlling our cognitive processes. They distinguish between primary and support strategies of information processing.

The following four categories represent *primary strategies* for cognitively handling information: recall, integration, organising, and elaboration (Tessmer & Jonassen, 1988). *Recall strategies* focus on repetitive practice, as well as on organisational procedures for facilitating the learning of lists of information. They consist mostly of behavioural, verbal learning practices. The things one learns this way usually do not transfer to other tasks (Tessmer & Jonassen, 1988). *Integration strategies* are processing strategies for transforming information into a form that is easier to remember. They concern integrating new information into one's old cognitive schemas by relating the information to examples, or rewriting or retelling something in one's own words. In this

way, the learner is using prior knowledge to build bridges to new information. This practice might also restructure a person's old schemas (Tessmer & Jonassen, 1988; cf. Piaget, 1977 on schemas). *Organisation strategies* are about structuring and restructuring information to fit into one's old knowledge base. Determining how new facts relate to previous knowledge, finding key ideas, grouping information into categories, and outlining relationships between categories or ideas are all examples of organisational strategies (Tessmer & Jonassen, 1988; cf. Weinstein, 2005; Weinstein & Meyer, 1991). *Elaboration strategies* make information more memorable and understandable through adding personal meaning to the content. Generating implications or inferences of the content is one way of encouraging a deeper processing (Tessmer & Jonassen, 1988; cf. Smith[15], 2000; Weinstein et al., 2005; Weinstein & Meyer, 1991). The following tables list the elements in Tessmer and Jonassen's taxonomy of learning strategies. The next two tables illustrate the primary strategies, which, according to Tessmer and Jonassen (1988), are divided into *information processing strategies* and *active study strategies*.

Table 3 Information processing strategies (adapted from Tessmer & Jonassen, 1988)

Information processing strategies		
Recall:	-	Repetition
	-	Rehearsal
	-	Review
	-	Mnemonic
Integration:	-	Paraphrasing
	-	Metaphors
	-	Exemplifying
	-	Covert practice
Organizing:	-	Analysis of key ideas
	-	Categorization
	-	Outlining
Elaboration:	-	Analogies
	-	Synthesis
	-	Sentence
	-	Elaboration

Active study strategies, as specific information processing strategies, focus on how to improve learner activity for processing information (Tessmer & Jonassen, 1988), and can be divided into two groups: *study systems* and *material processing strategies*. In study systems, a learner follows a number of steps representing various learning strategies in order to facilitate information processing. Material processing strategies are various study tactics. Examples of these are overt learner activities such as underlining, note

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[15] Examples of cognitive strategies of adult learners found by Smith (2000) are: recalling, confirming, generating, diagnosis, translation, categorising, imaging, application, linking, rehearsal, comparing, trialing, experimentation, problem solving, practice, and deliberation.

taking, and summarising. These are based on integration and organisation where the learner utilizes primary information processing strategies.

Table 4 Active study strategies (adapted from Tessmer & Jonassen, 1988)

Active study strategies		
Study systems:	-	e.g. MURDER
	-	e.g. SQ3R
Material processing strategies:	-	Note taking
	-	Underlining

Tessmer and Jonassen's taxonomy of learning strategies is only one example of how cognitive strategies can be categorised. More examples are discussed in relation to context as an area of SRL.

Metacognition

I already briefly touched upon metacognition as a concept. Here, I will distinguish between various perspectives on metacognition in relation to the learning process. For instance, Azevedo and his colleagues (2013, p. 429) describe SRL as superordinate to metacognition. Metacognition is a specific kind of cognitive strategy; it is our thinking about our thinking. The concept was introduced already in the 1970s by Flavell (1979). Metacognition is our awareness and self-regulation of our cognitive strategies. Our ability to reflect on what we are learning is an important metacognitive process (Gagné et al, 2005). Metacognition refers to the awareness we have of our own knowledge-building process, i.e., knowing about our cognition, what we understand, how we can manipulate information in order to learn better, and in other ways be aware of how to control our thinking (Azevedo & Aleven, 2013; Pintrich, 2005; Tsai, 2009). Metacognitive control and regulation includes planning, monitoring/setting benchmarks, evaluating goals and progress (Randi & Corno, 2005, p. 669-670).

Winne and Perry (2005) emphasize how metacognitive knowledge and metacognitive monitoring have been explored in contemporary research (they refer to the work of Pintrich, Wolters & Baxter, 2000) and how metacognitive knowledge is different from our ability of metacognitive monitoring (Table 5). Metacognitive knowledge is to know about cognitive strategies/tactics, how and where to use them most effectively and efficiently, as well as judging one's own abilities in relation to the task. The difference to metacognitive monitoring lies in how learners are able to monitor and use this knowledge during the learning process, for instance, the ability to know when they are learning, or how difficult learners think a learning task will be. Their distinction is congruent with the differentiation discussed earlier regarding declarative, procedural, and conditional knowledge about learning strategies (Weinstein, et al., 2005).

Table 5 Overlap of terminology related to metacognition

Metacognitive knowledge	- Knowledge of fine-grained cognitive operations that comprise cognitive tactics - Knowledge about strategies that articulate cognitive tactics - Procedural knowledge that enacts cognitive tactics - Conditional knowledge about occasions to enact cognitive tactics - Knowledge of tasks' parameters (e.g., resources, standards for success) - Knowledge of self-parameters (e.g., interest, effort)
Metacognitive monitoring	- Difficulty in addressing the task (ease of learning, EOL) - Match of achievement to standards (judgments of learning, JOL) - Probability of retrieval from long-term memory (feeling of knowing, FOK) - Confidence about the accuracy of monitoring
Metacognitive Control	- Skills for regulating metacognition
Metacognitive strategies/skills	- Procedural knowledge about strategies (e.g., orienting, planning, self-monitoring, evaluation) - Metalearning strategies for managing and monitoring cognition
Metacognitive experience	- Experiences manifested during task processing - Active metacognitive knowledge - Task-specific knowledge - Metacognitive judgments/estimates - Metacognitive feelings - Connected to motivation and affect

Azevedo and his colleagues (2013, p. 429) frame the difference between metacognitive monitoring and metacognitive control in a similar manner. They see both as important parts of SRL. Metacognitive monitoring includes our knowledge of cognition or metacognitive knowledge, while metacognitive control includes our skills for regulating our metacognition. However, researchers such as Efklides (2011) argue that metacognitive experiences also may have an affective character, and therefore, motivation and affect need to be explored in relation to metacognition. She refers to metacognitive experiences as "active metacognitive knowledge, metacognitive judgements/estimates, and metacognitive feelings". These metacognitive experiences are manifested during task processes and play a complex role in e-learning management for which they facilitate regulation of task-specific knowledge (ibid, 2011, p. 8). Hence, self-monitoring is a metacognitive process related to feelings of mastery, which Efklides refers to as metacognitive experience. Similarly to the concept of metacognition, Tessmer and Jonassen (1988) use the term *metalearning strategies* for how learners manage and monitor cognitive processes. These deal with awareness, knowledge, how to monitor cognitive goals, experiences, and actions. The purpose is to increase understanding and retention of what we learn. It is based on the principle of meta-memory: a learner's self-awareness of learning abilities, such as storing and retrieving from memory.

Learning approaches in relation to cognition

While a learning strategy is a concrete action to achieve a goal, a learning approach signifies the way learners choose to deal with a learning situation based on their beliefs about what learning is. Hence, how we approach a learning task cognitively is influenced by our epistemic belief; that is, our conceptions of knowledge and learning (Greene et al., 2010). Two contrasting views on learning are to see learning as a person's accumulation of pieces of information, and to see learning as a change in a person's conceptions of himself and understanding of the world (Entwistle, 1986). An evolved list in relation to this is presented by Illeris (2007), who compiles four types of learning: cumulation, assimilation, accommodation, and transformation. These types describe variations of the appropriation process in learning; how we organise knowledge, understanding, thinking, and memory. Cumulative learning[16] is rote learning and memorisation of details in a mechanic manner. Assimilative learning is adding new information to old schemas, while accommodative learning changes old schemas by transcending prior conceptions of something requiring a deeper reflection process. These two lastly mentioned types are based on the work of Piaget (e.g., 1977). Transformative learning is a more profound transformation of how we understand something, related to moments of epiphanies where several schemas are restructured. Words used to describe this type of learning and change in a person are, for instance, catharsis[17], significant learning[18], expansive learning[19], transitional learning[20], and transformation[21].

Marton and his colleagues (Marton, Dall'Alba & Beaty, 1993) asked people to describe what they thought learning is. Through this approach, they wanted to explore the variation of people's conceptions of learning, as they saw this conceptual understanding as affecting how people approach a learning task, i.e. which strategies they used for learning. They found six levels of how people conceive what learning is. The levels are, similarly to Illeris' typology, cumulative and go from a lower level of thinking to a higher level: 1) increase of knowledge, 2) memorising/reproducing, 3) applying, 4) understanding, 5) seeing something in a different way, and 6) changing as a person. These six hierarchical categories can be divided into two groups with regard to how people approach learning tasks. The first three levels can be defined as surface learning, while the last three levels constitute deep learning. Surface and deep learning approaches influence a learner's strategic behaviour (activities for learning), cognitive processing and affective connection to the learning task (Marton et al., 1993; Biggs, 1987; Richardson, 2000; Richardson, Morgan & Woodley, 1999). A surface approach is when a learner focuses on memorising and/or is extrinsically motivated, i.e. the objective is to

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[16] Illeris is referring to cumulation as defined by Thomas Nissen in his book Indlaering og paedagogik (1970).

[17] Sigmund Freud

[18] Carl R. Rogers

[19] Yrjö Engeström

[20] Peter Alheit

[21] Jack Mezirow

pass a course with minimum effort in order to receive a grade. A deep approach is when the learner focuses on understanding something, and is intrinsically motivated for learning; i.e. he/she develops a personal interest in the learning task. One important difference between a surface and a deep approach is that with a surface approach, the learner is focused on "the sign": the text as such, whereas with a deep approach the focus has shifted towards "the signified"; the meaning behind the text (Marton et al., 1993).

The intention is one important key to choice of approach, and here the context has an impact. For this, the division between surface and deep approaches has been scrutinized, as it has been found to vary between contexts (Case & Marshall, 2004). For instance, Eklund-Myrskog (1996) did a similar study to that of Marton and his colleagues (1993). She found a somewhat different categorisation in her study and related this difference to the importance of context. In her study she found two levels of applying. One was on a surface level of learning and consisted of students' conception of learning in terms of "applying knowledge, based on knowing how to do something". The other conception was defined as "applying, based on understanding", and was categorised as deep learning. She investigated vocational training students, who related their learning to the context of applying knowledge in terms of doing something hands-on at school or applying their knowledge in their future work situation. In the table below, hierarchical categorisations of learning conceptions (Marton et al. versus Myrskog-Eklund) are listed, in which surface and deep learning create a dividing line between the categories. In Marton et al.'s categorisation, applying falls into the surface learning category, whereas Eklund-Myrskog's categorisation of applying is related to context, and, accordingly can be described as either surface or deep learning.

Table 6 Conceptions of learning categorised as surface or deep learning

Learning approach	Conceptions of learning (Marton et al.,1993)	Conceptions of learning (Eklund-Myrskog, 1996)
Surface learning	1) Increase of knowledge 2) Memorising / reproducing 3) Applying	1) Keeping in mind 2) Applying, based on knowing how to do
Deep learning	4) Understanding 5) Seeing something in a different way 6) Changing as a person	3) Applying, based on understanding 4) Understanding 5) Getting a new perspective 6) Forming a conception of one's own

In the distinction between surface and deep learning we can understand that a person's conception of learning influences how this person goes about his/her learning in concrete action; the choices of actions one takes in order to learn something. Richardson (2000) summarised research studies exploring the issue of approaches to learning. He found results pointing to the fact that the approach one has towards a learning task (surface vs. deep) is dependent on factors such as learning context, level of motivation, goal orientation, expectations of assessment, and expectations of outcome. There is, furthermore, a third approach, which can be linked to either surface or deep learning.

This approach is referred to as an achieving approach (Biggs, 1987). Surface-achievers use strategies such as memorisation for the purpose of achieving high grades, while deep-achievers focus on both comprehension and high grades, and are, therefore, usually more successful learners. However, learning approaches are context dependent – not a stable learner profile as such. By measuring learning approaches in a certain context, it is rather the teaching and assessment style that is measured (Biggs, Kember & Leung, 2001). When designing for learning, a significant objective is to steer learners towards a deep learning approach. We want learners to understand the content, "the signified" behind a text or a course material, and to create their own understanding of it based on their experiences of the content. Why a learner choses a surface approach instead of a deep approach might be due to extrinsic factors such as assessment style (Richardson, 2000). However, it might also depend on intrinsic factors, such as our emotions. Emotions are seen as a parallel system to our cognition (Oatley, Parrott, Smith & Watts, 2011), which takes us to the second area Pintrich lists in his framework of SRL: affect and motivation.

4.3.2   Affect and motivation

There is a somewhat confusing use of the term affect in relation to emotion and feeling. According to the Merriam-Webster Dictionary, the word affect[22] is defined as "the conscious subjective aspect of an emotion considered apart from bodily changes". Emotion[23] is often used synonymously to affect. It is defined as "the affective aspect of consciousness; a state of feeling; a conscious mental reaction (as anger or fear) subjectively experienced as strong feeling usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body". The word feeling[24], is similarly referred to as an emotional state or reaction. Efklides and Volet (2005) differentiate between feelings and emotions for the purpose of understanding their impact on cognitive processing for learning. Feelings are more abstract and triggered by subtle cues, while emotions can be linked to concrete stimuli in a situation. Feelings have a hedonic quality and are assumed to monitor states of satisfaction of the learner. Efklides and Volet refer to (meta)cognitive feelings as a function of monitoring cognitive processing as these feelings trigger control decisions. In contrast to this, "emotions control action that leads to engagement in or suspending of action related to learning" (ibid, 2005, p. 377-8). Emotions have been linked to our ability to make decisions and choices on a cognitive level (Damásio, 1994; Oetley et al., 2011), and is therefore of interest also from a learning perspective and how we make choices for learning (Goleman, 1995). Although the connection between cognition and emotion seems rather obvious today, it is only in the last few decades that it has been regarded as an important factor. Emotions and cognition are integrative and interactive processes in all facets of learning (Coles, 1999). Fleckenstein (1992, p. 448) suggests that affect

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[22] http://www.merriam-webster.com/dictionary/affect
[23] http://www.merriam-webster.com/dictionary/emotion
[24] http://www.merriam-webster.com/dictionary/feeling

rather should be used "as an umbrella term to include emotions, feelings, preferences, beliefs, attitudes, motivations, and evaluations". She sees this affective continuum as a "cognitive-affective dance" illustrated as in the figure below. The darker top indicates that the affective focus is dominating the experience, while the brighter bottom indicates that the experience is mostly cognitive. Hence, emotions, feelings, moods, and preferences are clustered at the top. I refer to the term affect, in this context, as the emotional responses and reactions a person has in relation to the learning situation.
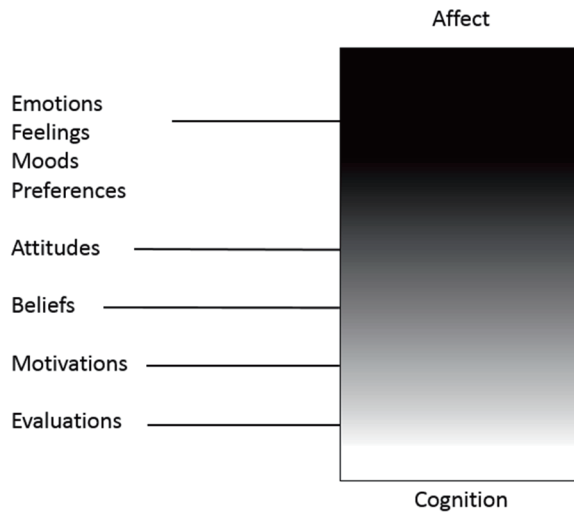
Figure 10 Affective-cognition continuum (adapted from Fleckenstein, 1992, p. 449)

In learning, there are multiple forms of affect, dynamic in nature, involved at various phases of the learning process, and situated at a person-context interface (Efklides & Volet, 2005). Although the design of learning technology is by nature a messy business (Koehler & Mishra, 2008), not the least because of the cognitive-affective dance. But the multitude and dynamics of affect and cognition is also a potential to address in the design, as it provides options to design for multiple goals targeting both cognition and emotion. The reactions towards learning tasks may, for instance, be defined as positive or negative. An e-learner's negative cognitive experience might be caused by too much cognitive load (Leahy et al., 2004), while a negative emotional experience might be caused by too much affective load (Nahl, 2004; 2005). However, a more fine grained perspective on the relation between affect and SRL is needed, especially in relation to e-learning contexts (Azevedo & Aleven, 2013). The aim should be to "change the undesired effects of emotions and feelings or to enhance affect that promotes learning" (Efklides & Volet, 2005, p. 379). Pintrich (2005) identifies affect and motivation as one of the areas of SRL. However, affect does not equal motivation, although they are intricately connected. For instance, emotions are seen as important influences of motivation (Järvenoja, 2010). Motivation is often described as a person's drive to obtain a goal. How we manage our learning process with regard to motivational regulation is, therefore, linked to how we set goals, choose tasks, and stay engaged to obtain these

goals. Some argue that future goals, such as the long term motive for studying in order to earn a degree, is important in the development and regulation of short term sub-goals (Miller & Brickman, 2004). Hence, from a design perspective, we need to understand the value of both short term and long term goals as it impacts SRL.

Regulation of affect and motivation

Regulating affect and motivation is an important steering process for learning (Randi & Corno, 2005), and luckily, it is something we can develop as an ability. Unlike IQ, referring to our cognitive ability, which is rather stable throughout life, EQ (emotional intelligence) is open for improvement, and the regulatory aspect is one key (Goleman, 1995). How we manage, that is, regulate our motivation is an essential building block of what constitutes our emotional intelligence, also referred to as EQ, a term introduced by Goleman (1995; 1998). Most research on affect has dealt with motivational regulation. However, Pintrich (2003) suggests that research also needs to look beyond this perspective into how self-regulatory strategies might reciprocally and recursively influence motivation.

Emotional control involves visualization and mental imagery (Randi & Corno, 2005, p. 669-670), and also coping strategies for handling negative emotions (Pintrich, 2005; Boekaerts, 1993). These kinds of regulatory strategies were investigated by Ben-Eliyahu and Linnenbrink-Garcia (2013). They criticize earlier research on SRL for disregarding emotional self-regulatory strategies (cf. Pintrich, 2003). They claim that these are just as important for learner engagement as cognitive and behavioural strategies. In their research they studied reappraisal, suppression, and rumination as ways to regulate emotions in learning situations. Reappraisal is used, for instance, for diverting anxiety by focusing on something positive instead. Suppression might be used by someone who easily becomes overexcited, in order to control his/her emotional reactions in the situation. Rumination is a maladaptive emotional regulation strategy, as it includes incessant over thinking, which drains cognitive resources. Ben-Eliyahu and Linnenbrink-Garcia (2013) found that rumination was associated with negative emotions and linked to less liked courses, while reappraisal was found to be linked to positive emotions and favourite courses. However, further research into emotional self-regulation is needed.

Pintrich (2005) describes motivational regulation as an ability to control and monitor motivational beliefs, According to his framework of SRL, the motivation regulation process is present at all the four phases of SRL. At the first phase of forethought, planning, and activation, one adopts a certain goal-orientation towards the task, makes judgments about one's efficacy and the effort needed, the difficulty of the task, as well as activating one's interest and task value. As such, the purpose a learner feels for doing a task is highly involved in the regulation of goal-orientation for motivation. The self-efficacy and competence a learner feels for performing a task is another important aspect of motivational regulation. The beliefs about the importance, utility and relevance of the

task, as well as the learner's own interest in the task, are other belief factors affecting motivational regulation (ibid, 2005). The second phase, monitoring, is one's awareness of motivation and affect, as well as how one monitors these intrinsic states. The third phase, control, has to do with the concrete strategies one selects and adopts for managing motivation and affect. Finally, the fourth phase, reflection and reaction, is how one attributes success and failure, as well as one's affective reactions to the learning task and one's learning process related to it (Pintrich, 2005). Tessmer and Jonassen (1988) categorise preparation or execution strategies for building the right mood and psychological state for optimal learning for the learner. These strategies are aimed at preparation and execution of learning, and may be interlaced with what they name primary and secondary learning strategies. For instance, anxiety reduction and relaxation techniques are important to master in order to facilitate information processing. However, to this category, they also include abilities to manage time for studies, keep up concentration during study periods, as well as goal setting and goal imaging for monitoring progress and performance (Tessmer & Jonassen, 1988).

Motivation and volitional control: Greene and Azevedo (2007, p. 363) state that "[m]otivation can be seen as both a product, in terms of the current state of motivation, and a process, in terms of the actions taken to motivate oneself". How we control motivation is by some referred to as volitional control (cf. Kuhl, 1985; 1987) involving "one's capability of maintaining attention and effort toward goals in spite of possible distractions due to waning motivation or competing goals" (Deimann & Keller, 2006, p. 2). Therefore, motivation can be seen as the process before selecting a goal, and volition[25] as the process of efforts to reach the goal (see Figure 11). Firstly, motivation as a process during learning involves initiation of a learning activity, as well as assigning value to the task at hand. Secondly, one has to motivate oneself enough to get started, and thirdly, sustain effort to complete the task (Boekaerts & Cascallar, 2006). The regulation of motivation, therefore, becomes a process of interest to this study.

Järvenoja and Järvelä (2005, p. 467) provide a "conceptual framework for the analysis of students' emotional experiences during the volitional phase of the learning process" (Figure 11). The framework is theoretically grounded in prior research on motivation and volition. It is based on the assumption that we need to recognise and regulate emotional experiences in order to successfully monitor our volition in learning (Järvenoja & Järvelä, 2005). The framework highlights that there are many sources for learners' emotional experiences during learning; for instance, conceptions of self, of the task, of their performance, of the context, and of the social aspects of the learning situation. These are all affected by the learners' prior experiences (cf. Hassenzahl, 2010 on user experience). The figure illustrates how the motivational phase and the volitional phase entail a continuum in which the goal commitment is the threshold between the flow of the two.

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[25] Volition as a psychological concept can be traced back all the way to William James's writings in 1902.
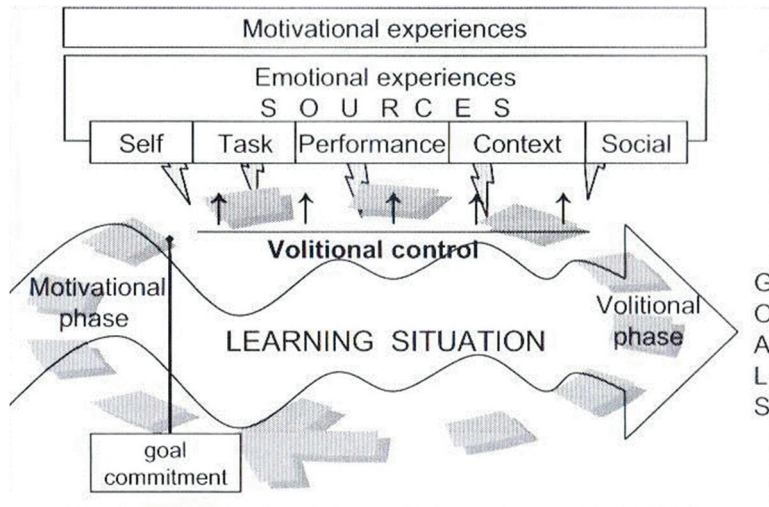
Figure 11 Motivation and volition (adapted from Järvenoja & Järvelä, 2005, p. 468)[26].

Zimmerman (1994) highlights the difference between the terms intrinsic motivation and being self-motivated. Intrinsic motivation often refers to the task being the trigger, while the term self-motivated refers to self-efficacy perceptions and self-regulatory processes as being the cause of motivating the learner. In other words, to be self-motivated is to be able to regulate motivation and maintain volitional control, whether it is through managing extrinsic or intrinsic motivational regulators. No doubt, to be in control of motivation demands positive thinking, endurance, and self-reliance (Randi & Corno, 2005), but also awareness of how affect impacts our learning and motivation (Burleson, 2013).

Meta-affective awareness

Pintrich (2005, p. 462) hesitantly suggests the term "metamotivation" (cf. Boekaerts, 1996) as a concept for awareness of how to control and regulate motivation for learning. Burleson (2013) takes this a step further in the design of intelligent computer tutoring systems that can support learners in becoming aware of their affective states during the learning process, and based on this awareness, be able to develop and use metacognitive strategies and persist throughout frustrations and challenges. Burleson (2013) grounds his work on Flavell's definitions on metacognition and defines meta-affective concepts in the following way:

> *Meta-affective knowledge* is knowing how affect impacts one's thinking ability. [..] *Meta-affective experience*, then, is a conscious reflection of one's own feelings and how they steer one into action, or inaction. [..] Finally, *meta-affective skill* is the ability to

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[26] © 2005 by Elsevier Ltd.

synthesize meta-affective knowledge and meta-affective experience: to, at a time of meta-affective experience, apply one's meta-affective knowledge. (Burleson, 2013, p. 648)

In Burleson's research, multiple user data are collected through various sensor inputs[27], and interpreted into interactions by an Affective Learning Companion (ALC), which is an avatar on the screen. The learner may then select options of multiple text responses from the ALC (Burleson, 2013). Similarly to Burleson's attempt, Nahl (2012) uses a simpler approach of concurrent structured self-reports. This is applied in the context of Second Life, to engage users in both metacognitive and meta-affective reflection in order to manage in the face of negative emotions. These two examples represent extrinsic efforts to support and build learners' meta-affective awareness, as a tool for emotional and motivational regulation, that is, to develop volitional control of their learning.

Motivation and social context

Relatedness is one key factor affecting our motivation in learning (Deci & Ryan, 2000). This brings in the social context as an important influencing factor for our motivation. While Pintrich's framework stems from a socio-cognitive perspective on SRL, which takes environmental influences into account, the situative approach expands further on this aspect in discussing motivational regulation. This approach interprets motivation as an active process, which is contextually bound and highly dependent on both participation and collaboration with others. This represents the atheoretical question of 'where', according to Zimmerman (1994). Järvenoja (2010, p. 21) argues that "situation-specific motivational states are contextualized reactions and interpretations of the current situations and can vary from situation to situation." These states are, for instance, motivation regulation, emotional arousal, beliefs, and goal-orientation (cf. Nahl, 2012).

In traditional self-reporting measurements of SRL, the concept of co-regulation, or something similar, does not exist. There usually is a scale for measuring Help-Seeking activities (cf. Pintrich, 2005; Ruohotie, 2000; Susimetsä, 2006; Zimmerman, 2005), which include statements indicating a co-construction of knowledge in the learning process. The concept of Help-Seeking, however, implies that this is merely a 'help' in the SRL process, while socio-cultural theories emphasize the co-construction process in learning, suggesting that learning is to a large extent influenced by co-regulation and socially shared regulation rather than self-regulation (Järvenoja, 2010). The context often has a social dimension to it, and affective strategies seem to involve this social dimension. For instance, the social/affective strategies of VET-students found by Smith

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[27] "The chair is outfitted with a high-density array of force-sensitive resistors (FSR; the mouse detects use through pressure on similar resistors, and, a wireless skin conductance sensor with two electrodes on a wristband was worn by the student." (Burleson, 2013, p. 648)

(2000) highlight the social context, as these include worker observation, demonstration, and discussions with fellow workers, peers, trainers, or supervisors.

Motivation in e-learning seems to be tightly linked to social aspects. Similarly to the VET-students' social/affective strategies, Saunders (1998) found that e-learners were using affective learning strategies in the form of interpersonal networking in order to cope with the e-learning environment. Nahl (2012) found that feelings of being excluded from communication in Second Life caused an affective load that resulted in increased motivation to develop skills for communicating better in the e-learning environment. Hence, the affective load, in this case, had a positive outcome and was a means for motivational regulation. However, from a motivational perspective, there are often more challenges facing a learner in a computer-supported collaborative learning environment than in a traditional learning environment (Järvelä, Hurme & Järvenoja, 2011). The challenges involve "adaptation to complex social learning practices, such as sharing knowledge and maintaining coordinating activities" (ibid, p. 33), and also to find new ways of shaping one's identity in this interaction (Persaud & Eliot, 2014). Therefore, it is suggested that a self-regulated e-learner needs socio-emotional skills (Järvelä et al., 2010).

Järvenoja (2010, p. 67) wrote in her dissertation *Socially Shared Regulation of Motivation and Emotions in Collaborative Learning* that "co-construction of motivation is activated through shared regulation processes, which maintain and channel group activity". This is also evident in the category of *Collective Motivation* found by Susimetsä (2006) while investigating collective online learning. However, Järvenoja (2010, p. 68) also argues that we can equally use individual self-regulation strategies in order "to overcome socio-emotional challenges". Furthermore, socially shared regulation does not require a shared understanding or a shared interpretation of the situation as such. The co-construction of motivation happens through a shared regulation process. However, having a shared goal for learning does benefit this process (ibid, 2010).

A study on adult e-learners in Japan (Kikuchi, 2006) also revealed that e-learners were motivated by collaborative interaction with peers and in group activities. However, motivation was individually different between novice e-learners and those with earlier experiences of e-learning. The novices were more likely to set goals individually, and have a higher curiosity about e-learning. However, they also required more encouragement for independent learning. Experienced e-learners were motivated by flexibility and interdependence. Sharing the rewards with family was another motivator for them. These results suggest that the more experienced one becomes, the more impact the social context has on one's motivation (Kikuchi, 2006). The importance of social feedback was also evident in another study on undergraduate students being examined for their e-learning strategies, in which face to face teaching/learning was highly valued by the students (Zariski & Styles, 2000).

In another study on adult learners' experiences of self-directed[28] e-learning, a number of instructional factors were either contributing to motivating the learners, or the opposite; i.e., making the learning situation more motivationally challenging. Activities representing authentic and interactive features including simulations and animations proved to increase motivation. However, a positive learning climate, as well as learner control of pace and sequence of instruction, had a positive impact on motivation. Factors that seemed to demotivate learners were the opposite of the above mentioned positive factors: low interactivity and no possibility for application or integration of the content (Kim, 2009). This rimes well with earlier research on the needs of adult learners to be able to apply new knowledge (Brookfield, 1996; Conlan et al., 2003; Knowles, 1973), as well as learners' need for autonomy, competence, and relatedness in order to be intrinsically motivated (Deci & Ryan, 2000). Based on these prior research studies, it is evident that social context has a great influence on motivation. This seems to be just as important to consider in e-learning contexts, and especially if there are novice e-learners. Furthermore, factors that influence motivation positively include social factors, content related to real life problems, and also instructional design for flexibility, autonomy, competence, and relatedness.

4.3.3   Behaviour

The next area of SRL (according to Table 2) is learners' regulation of behaviour, referring to overt, visible actions for learning. Pintrich (2005, p. 466) argues that "indviduals can observe their behavior, monitor it, and attempt to control and regulate it, and, as such, these activities can be considered self-regulatory for the individual". As Pintrich's SRL framework stems from the triadic model of social cognition (Bandura, 1986; Zimmerman, 1989), he includes behaviour as one of the areas of SRL, although many SRL models do not include it as a separate area. However, Pintrich emphasizes that the SRL area of behaviour is closely linked to cognition, as behavioural planning always involves cognition[29]. Likewise are the other phases of SRL, such as monitoring and awareness of learning behaviours, as well as reaction and reflection, dependent on the learner's cognition. The separation of behaviour from cognition and motivation has been criticized by, for instance, Efklides (2011). Behavioural control and regulation involves strategies for time management, effort, and persistence (Pintrich, 2005). Here again, Efklides (2011, p. 9) argues that learners' "awareness and monitoring of effort cannot be dissociated from" their awareness of metacognitive experiences, such as feeling of difficulty, ease of learning, and judgments of learning. According to Pintrich (2005), help seeking is another behavioural strategy, although it involves a contextual control aspect and sometimes social interaction.

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[28] referring to the independence towards choice of content in relation to instruction, as discussed earlier regarding the difference between self-direction and self-regulation

[29] The brackets in the cells of the columns of behaviour and context in Table 2 indicate that the cells' contents are aspects of cognition.

In an e-learning environment learners' overt behaviour is visible in how learners interact with the environment and the content. Studies on e-learners' activities for learning have shown that the use of learning strategies can predict academic achievement (Lee, 2004; 2009). Nevgi (2002) developed a self-rating tool for measuring the learning strategies and resource management strategies of virtual university students. She points to the fact that persistence is a necessary strategy of resource management in e-learning environments as she found high correlations between persistence, time management and self-regulation, whereas help-seeking (as a resource management strategy) fell into a separate category. These results differ from the forerunners of similar measurement tools for traditional face-to-face learning situations (Pintrich et al., 1991; Ruohotie, 2000). Hence, we can assume that help-seeking as a strategy takes a different form in e-learning than what has been found in traditional learning studies.

Behavioural control and regulation further involves motivational strategies for avoiding procrastination. In a study (Michinov, Brunota, Le Boheca, Juhela & Delavala, 2011) targeting the relation between motivation and procrastination in online learning it was found that the social aspect is important for both motivation and successful online learning as high procrastinators were found to be less motivated. There was also a negative relationship between procrastination and successful performance in online learning. This relationship correlated to how much learners participated in discussion forums. The researchers conclude that "it appears that if high procrastinators are less successful online learners than low procrastinators, it is partly due to their lack of participation in discussion forums during the learning process" (Michinov et al., 2011, p. 243). This kind of research highlights the importance of designing e-learning environments that encourage social-emotional involvement and facilitate participation in task discussions; i.e., designing for behavioural interaction where learners are supported in both observing and reflecting on their choice of actions. This would help learners in becoming aware of how they can monitor and manage their behaviour to improve their online learning.

4.3.4   Context

It seems to be almost impossible to discuss the different areas of SRL without touching upon their relation to context. Prior research on SRL has continuously shown that the context affects our learning. For example, variations in learning contexts have shown to provide variations in emotional and motivational challenges for learners (Järvelä, 2001; Järvenoja, 2010), as well as how learners adapt to assessment style by changing their own cognitive learning approach accordingly (Richardsson, 2000). Context, as an area of SRL, involves learners' "attempts to monitor, control, and regulate the context as an important aspect of self-regulated learning" (Pintrich, 2005, p. 469). Similarly, Azevedo and his colleagues (2013, p. 429) state that SRL includes "processes related to manipulating contextual conditions and planning for future activities within a learning episode". Context seems to be an ever present aspect of learning, influencing most other

factors. Likewise, it is also an important factor in the design of the present research study.

In accordance with the phases of SRL in Table 2 (adapted from Pintrich, 2005, p. 454), the first phase, learners' forethought, planning, and activation, is dependent on learners' knowledge and awareness of contextual norms and climate. Learners' perceptions of contextual factors, such as levels of autonomy, rules of conduct, conceptions of knowledge and learning, as well as hidden teacher biases, may influence their "knowledge activation of contextual information" (Pintrich, 2005, p. 469). Contextual monitoring involves learners' awareness of both affordances and constraints of the environment. This is crucial for them to be able to control and regulate the environment. One perspective on SRL is to target how learners find ways of managing and building successful learning strategies (actions), regardless of how well the environment is actually facilitating learning (Zimmerman, 1990). This is interesting from the perspective of a novice e-learner's development and regulation of learning strategies in a new e-learning environment, in which his/her learning needs might not be met, and learning might not be facilitated in ways that the learner is used to. Therefore, the learner is dependent on his/her capability of being flexible and adaptive for learning in this new learning space. Vohs and Baumeister (2004, p. 2) describe this learning adaptability and flexibility when they say: "self-regulation refers to the exercise of control over oneself, especially with regard to bringing the self into line with preferred (thus, regular) standards". However, according to Winne (2010, p. 268), "self-regulated learning is contextual" and that context in itself evolves as learners regulate learning.

Weinstein's (1994) model (Figure 12) is an illustration of important determinants of the learning process, of which self-regulation is one of the three internal factors. The external factors of the context are illustrated as the outer frame in the model, representing the nature of the learning task, time constraints, social context, support, available resources, as well as teacher beliefs and expectations. The individual differences are illustrated by the inner triangle of the model, which represents how we master our individual factors of skill, will, and self-regulation (Weinstein et al., 2005). The model illustrates how learning is more than just cognition. It is an internal process of affective, cognitive, and behavioural factors where the end result is dependent on our ability for self-regulation and being a strategic learner in relation to the specific affordances and constraints of the context. In accordance with the model, this entails our knowledge about the task and ourselves as learners, as well as our skills in using learning strategies efficiently. It also includes our will for learning, i.e., our ability for goal-directedness, as well as for managing our motivation and affect.

NATURE OF THE LEARNING ACTIVITY, ASSIGNMENT, PROJECT OR TEST / TIME CONSTRAINTES

SKILL

Knowledge about ...
- Self as a Learner
- Nature of Academic Tasks
- Learning Strategies and Skills
- Content (Prior Knowledge)
- Learning Context

Skill in ...
- Using Learning Strategies and Skills
- Finding the Main Idea or Identifying Important Information
- Reading and Listening Comprehension
- Listening and Note-taking
- Preparing for and Taking Tests
- Using Reasoning and Problem Solving Skills

LEARNER
(... Individual Differences)

WILL
- Setting, Analysing, and Using Goals
- Motivation for Achievement (i.e., Academic Learning Goals, Interest and Values)
- Affect Toward Learning (e.g., Curiosity, Worry, Apathy, Anger, and Academic Stress)
- Beliefs (e.g., Enabling /Self-Sabotaging Beliefs, Academic Self-Efficacy and Attributions for Academic Outcome)
- Volition (e.g., Commitment and Intention)
- Creating a Positive Mind-Set Toward Learning and Avoiding Self-Sabotaging Toughts and Behaviors

SELF-REGULATION
- Time Management / Dealing with Procrastination
- Concentration
- Comprehension Monitoring
- Systematic Approach to Learning and Accomplishing Academic Tasks (e.g., Set Goals, Reflect, Plan, Select, Implement, Monitor, and Formatively Evaluate Progress, Modify (if necessary), and Summatively Evaluate Outcome
- Coping with Academic Stress
- Managing Motivation for Learning and Achievement

AVAILABLE RESOURCES

TEACHER BELIEFS / EXPECTATIONS

SOCIAL CONTEXT / SUPPORT

Figure 12 Weinstein's model of SRL (adapted from Weinstein, et al., 2005, p. 734)[30].

The e-learning environment provides a new context for learners, especially when the learning is designed to be independent and self-paced. It also has the added factor of technology, which needs to be managed, in addition to the content. Technical problems may, for instance, easily overshadow effective learning strategies, which was evident in a study examining e-learning strategies used by undergraduate students (Zariski & Styles, 2000). Therefore, it can be hypothesized that this contextual change calls for adaptation of learning and how learners can be self-regulated. Based on this assumption, Tsai (2009) used Weinstein's (1994) model as a springboard for developing a model of strategic e-learning (Figure 13). The adapted model illustrates both the characteristics of the e-learning context, as well as the characteristics of e-learning strategies. The contextual determinants are depicted as a frame of four dimensions: the nature of e-learning tasks, online social supports, available online resources, and online learning systems. The e-learning environment is characterized by four identifiers, which all present different challenges for e-learners: flexibility in time and space, indirect social interaction, abundance of information, and dynamic learning interfaces. The core domains of the learner (skill, will, and self-regulation: similar to the inner triad of Weinstein's model above) have been explored through in-depth interviews with e-learning students. Based on the data from these in-depth interviews, Tsai (2009) discusses what the concepts of skill, will, and self-regulation entail for learning online. The concept of perceived-skill includes comprehension, Internet skills, and self-awareness. E-learners need mature cognitive and metacognitive skills in order to be able to construct meaning and process information presented in an open-ended structure of

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[30] © 1994 by C. E. Weinstein.

the context, such as hypertext and the Internet, as these environments are more complex than traditional learning settings. Basic skills needed for e-learning are online search skills, online discussion skills, Internet file transfer skills, etc. Being self-aware in an e-learning environment, is to know about oneself as an online learner in relation to course obligations and responsibilities. It is the ability to know what one needs to do and the skills one needs to have in order to succeed in this specific e-learning context (ibid, 2009).
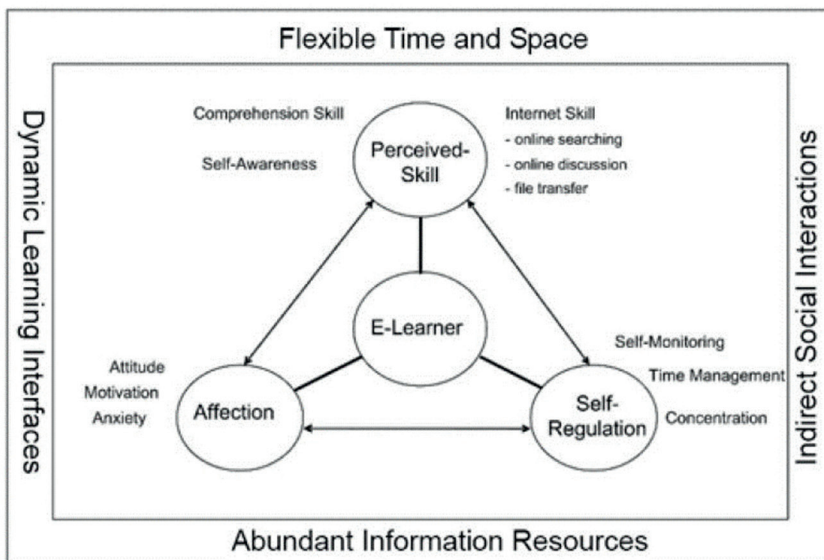
Figure 13   Tsai's model of SRL online (adapted from Tsai, 2009, p. 41)[31].

The concept of will, or affection (as Tsai refers to it), includes attitudes, motivation, and anxiety. How students feel about the e-learning environment will affect their willingness to interact with it. E-learning motivation is by some considered to be more complex than in traditional learning. For instance, the concept of locus of control may have a different meaning and constellation. Furthermore, worry about e-learning is often related to the ability to manage the technology, and how to act socially and communicate in such an environment (Tsai, 2009).

Tsai's interview data further showed that the concept of self-regulation in e-learning contexts includes self-monitoring, time management, and concentration. Self-monitoring skills involve how students understand tasks and resources in order to be able to plan their studies and manage the tools available. E-learning is often independent and self-paced, which requires ability to plan time for study in a self-directed manner. In order to be able to concentrate in e-learning environments, students need to avoid

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[31] © 2009 by International Forum of Educational Technology & Society.

distractions online and manage the cognitive load, which is often ever present in e-learning environments and the Internet. Tsai (2009) suggests that the three concepts of perceived-skill, affection, and self-regulation are interrelated and skills in one will affect abilities and influence of the others.

Being aware of levels of expectations, as well as of contextually useful learning strategies, are also beneficial for optimal learning (cf. Weinstein et al., 2005 on conditional knowledge). In e-learning environments, where self-paced, independent learning is an everyday affair, researchers emphasize the importance of facilitating students' learning awareness through tutorial guidance for the development of effective learning strategies (Nevgi, 2002). Based on a similar assumption, Azevedo et al. (2010b) wanted to know how e-learning environments can be designed to adapt to learners' needs and scaffold SRL in accordance with SRL theories. They conducted a study to find out how online pedagogical agents facilitated SRL in a course on a complex scientific topic. This was done by comparing three groups facing different scaffolding in the online environment, MetaTutor, an intelligent hypermedia system. The students were either given both prompt and feedback for scaffolding SRL, only a prompt, or neither prompt nor feedback. The methods used for collecting information from 69 undergraduate students were concurrent think-aloud protocols, eye tracking data, human-agent dialogue, learning outcome measures, log-file data, metacognitive judgments during learning, embedded quizzes, and facial recognition data for affect classification. Based on the log-file data and the learning outcome data they compared the following: learning time with the whole content, time spent on pages and diagrams, the number of sub-goals generated, as well as learning efficiency. The last was calculated from the number of correct answers in the pre- and post-test divided by how much time an individual spent on tasks in his/her learning.

Azevedo and his colleagues (2010b, p. 14) conclude that "college students' learning about a challenging science topic with hypermedia can be facilitated if they are provided with adaptive prompting and feedback scaffolding designed to regulate their learning". The online pedagogical agents used to give timely prompts and feedback proved to be a successful way of facilitating students' SRL processes. Azevedo and another group of colleagues report from the same study that the group receiving both prompt and feedback had significantly higher learning efficiency scores compared to the other two groups. The log-file data showed that metacognitive monitoring and SRL were facilitated by the pedagogical agents (Azevedo et al, 2011).

Other researchers (Cordingley et al., 1998) also argue that the learning environment is a significant factor in affecting SRL processes, and that learning environments need to challenge learners to become active participants, provide opportunities to practice and develop self-regulation (Järvenoja, 2010), and to provide the tools to do so, as well as give immediate and adaptive feedback to learners (Bernacki, Aguilar & Byrnes, 2011). This is demonstrated by the above mentioned study by Azevedo and his colleagues

showing that the development of SRL strategies can be facilitated by using pedagogical agents in an e-learning environment (Azevedo et al., 2010b; 2011).

Variations of SRL in relation to context

The impact of context on SRL can be seen in how it has been measured in a variety of contexts by using the same research instruments. One example of this is the Motivated Strategies for Learning Questionnaire (MSLQ) created by Pintrich and McKeachie, based on their research (Pintrich et al., 1991). The MSLQ was originally used in schools and higher education. The questionnaire has further been adapted for, and used in, the context of adult learning (Ruohotie, 2000), adult collective online learning (Susimetsä, 2006), and computer-supported hypermedia learning (DiPaolo, 2001). In the following, the results from investigating SRL in these contexts will be summarized briefly.

In Table 7 and Table 8, the differences between contexts are highlighted, as the sub-categories found related to Motivation and Learning Strategies are compared to those measured by the MSLQ instrument. Traditional college learning (Pintrich) was investigated by the MSLQ. Professional learning (Ruohotie) was investigated by the Abilities for Professional Learning Questionnaire (APL), which is an adapted version of the MSLQ. Online collective adult learning (Susimetsä) was investigated by using the APL in addition to study journals. Computer supported adult learning (DiPaolo) was investigated by using the MSLQ in addition to interviews.

Table 7 Comparing motivation by context (adapted from Ruohotie, 2002, p. 62)

Traditional Learning (Pintrich/USA)	Professional Learning (Ruohotie/Finland)	Online Collective Adult Learning (Susimetsä/Finland)	Computer Supported Adult Learning (DiPaolo/UK)
Value components: - Intrinsic goal orientation - Extrinsic goal orientation - Task value Expectancy components: - Control beliefs - Perceived competence - Self-efficacy - Expectancy for success Affective components: - Test anxiety	Value components: - Intrinsic goal orientation - Extrinsic goal orientation - Meaningfulness of study Expectancy components: - Control beliefs - Self-efficacy Affective components: - Test anxiety	Value section: - Intrinsic goal orientation - Extrinsic goal orientation - Meaningfulness of study Expectancy components: - Control beliefs - Self-efficacy Affective section: - Performance anxiety Social motivation: - Social groundwork - Social support	Resource exploitation: - The resource is used because it is available Expectancy: - Expectations that using the resource will increase success in learning the domain Presentation format: - A comparison is made between the resource and other course material

Traditional learning context
The MSLQ is structured in accordance with the categorisation of our learning to involve both affect and cognition. The affective dimension includes, for instance, our motivation, values, and beliefs and how we are able to regulate these in order to increase our success in learning. The cognitive dimension involves our thinking, as well as our awareness and regulation of our thinking processes in a learning situation. The two categories are referred to as motivation and learning strategies in the MSLQ (see Table 7 and Table 8).

Motivation: The generic category of Motivation includes variables measuring goal orientation. There are two distinctly different goal orientations that are either stemming from intrinsic motives and personal interest in the subject, or extrinsic motives, which are outside pressures and forces providing external goals for learning (cf. Ryan & Deci, 2000). Another variable involves the value attributed to the subject to be learned. The beliefs we have about our ability to control our own learning also matter, as well as self-efficacy beliefs related to beliefs about our ability to perform and learn in a specific situation. Anxiety about tests are also measured in the MSLQ within the motivation category.

Learning Strategies: The generic category of Learning Strategies measures cognition and metacognition. The Cognitive Strategies include rehearsal, elaboration, organisation, and critical thinking, which are strategies for cognitive management of the content to be learned. Metacognitive self-regulation involves our awareness of our own thinking processes, as well as our ability to monitor and regulate these in successful ways. The generic category of learning strategies also includes how we are able to manage available resources, such as time and study environment. The social resources are included in terms of peer learning, and help seeking. Effort regulation is seen as a resource to be managed (Pintrich et al., 1991).

Adult professional learning context
An implementation of the work of Pintrich and McKeachie (e.g., Pintrich & McKeachie, 2000), has been made by Ruohotie (2000) in the field of adult professional learning in a Finnish context. He adapted the MSLQ to this context, and developed it into a new questionnaire for professional learning in the workplace called Abilities for Professional Learning Questionnaire (APL). One difference with the adult learners in vocational education, compared to traditional learning in schools (Pintrich et al., 1991), was that a distinction could be made between Metacognition in learning and Metacognition in practice, as well as another strategy named Learning by doing (see Table 8).

Ruohotie's results, pointing towards a separation between situations of learning and situations of practice, can be related to the study mentioned earlier on the conceptions of learning (cf. Cognitive learning approach) of students in vocational education (Eklund-Myrskog, 1996). This study similarly found differences between applying knowledge by doing, i.e., knowing how to do something, and applying knowledge by

understanding. Here, Eklund-Myrskog further defines the first category as surface learning, while the category of understanding represents deep learning. She investigated vocational training students, who related their learning to the context of applying knowledge in terms of doing something hands-on at school or applying their knowledge in their future work situation.

Online collective adult learning

Susimetsä (2006) continued the work of Ruohotie and used the APL-instrument to collect data from online adult learners. However, he also used students' study journals in his attempt to construct a model of collective online learning. The study journals were analysed phenomenographically in order to find variations of students' conceptions, which could not be detected by a pre-designed instrument such as the APL. The model includes four levels of factors affecting learners' achievement in collective learning situations: Individual motivation, Individual learning strategies, Collective motivation, and Collective learning strategies. His contribution related to the new context of online collective learning lies in the focus on the last two categories.

Collective motivation: This includes three sub-categories. The first category, Social groundwork, involves students' willingness to cooperate in their course work. The second category, Collective self-efficacy beliefs, involves how students believe in other group members' ability to cooperate in order to successfully complete course work. The third sub-category is Social support.

Collective learning strategies: Of the collective learning strategies, Susimetsä (2006) argues that Collective metacognitive strategies and Resource management strategies are the most important for successful collective online learning. He describes Collective metacognition as the group's skills to monitor cooperative work for the purpose of learning, while managing the resources involves both study time arrangements and using the environmental resources successfully.

Computer-supported adult learning

DiPaolo (2001) investigated students at the Open University in the UK, who had the opportunity to use a CD-Rom as additional learning material in a distance course. The original MSLQ was used, in addition to interviews with the students. He found that learning strategies used by the students differed from the strategies used in traditional courses. He found nine strategies totally, which were categorised according to three generic categories: Motivation, Cognitive strategies, and Resource management. These generic categories are the same as those identified in traditional studies by the MSLQ-instrument. However, the context impacted on the variation of the subcategories (micro-level strategies) within these.

Motivation: The first generic category, Motivational strategies, describes why learning happens and includes three subcategories, of which the first, Resource exploitation,

indicates whether the available resource is used. The second subcategory, Expectancy, involves learners' expectations about being more successful in the subject if they use the resource (CD-rom). The third subcategory, Presentation format, involves how learners make comparisons between the resource and other course material.

Cognitive strategies: The second generic category, Cognitive strategies, describes how knowledge is transferred to the learner, and includes three subcategories. Firstly, Knowledge focused involves how learners clarify and reinforce information encountered in other course material through the CD-rom content. Secondly, Note taking is used as a strategy for learning. Finally, Self-testing, as the third subcategory of the cognitive strategies, describes how learners check what they have learned by using Questions and Objectives as an instructional affordance of the CD-rom content.

Table 8 Comparing strategies by context (adapted from Ruohotie, 2002, p. 62)

Traditional learning (Pintrich/USA)	Professional learning (Ruohotie/Finland)	Online collective adult learning (Susimetsä/Finland)	Computer supported adult learning (DiPaolo/UK)
Cognitive strategies: - Rehearsal - Selection - Organisation - Elaboration - Metacognition - Surface processing - Critical thinking - Original thinking **Resource management:** - Time and study environment - Help-seeking behaviour	**Metacognition in learning:** - Planning - Self-monitoring - Self-evaluation - Critical thinking **Metacognition in practice:** - Planning - Self-monitoring - Self-evaluation **Learning by doing:** **Resource management:** - Time and effort	**Cognitive strategies:** - Rehearsal - Organisation - Elaboration - Critical thinking **Metacognitive strategies:** - Planning and self-monitoring - Self-evaluation **Resource management:** - Time and study environment - Effort **Social learning:** - Knowledge sharing - Peer learning - Feedback seeking	**Cognitive strategies:** - Knowledge focused - Note taking - Self-testing **Resource management strategies:** - Tool use strategy - Navigation - Use of support facilities

Resource management: The third generic category of DiPaolo's (2001) results, describes how learners fit in the study of the domain/task around their lives, i.e., the time they spend using the resource. This also includes three subcategories. The Tool use strategy simply indicates whether the tools were used. Navigation describes how the learners examined the CD-rom content either in its entirety, or selectively. Use of support

facilities involves how learners used instructions, as well as how and whether they saved records of the content.

DiPaolo's (2001) results can be related to an earlier study (Saunders, 1998) on computer-based learning. Here, the cognitive strategies found were separated between how students managed the computer environment with regard to management of computer-based information and with regard to the computer's text-based environment. Furthermore, the study categorised how students' managed personal resources, such as effort and time. The design of the computer-based course (e.g., its interactive potential) seemed to have impact on both cognition and affect of the e-learners (Saunders, 1998).

As can be seen in the two tables above (Table 7 and Table 8), context has an impact on what kinds of learning strategies are found, as these are essentially related to affordances and constraints of the environment. Likewise, motivation and affect are influenced by the factors available in the context; for instance, are peers available as social support, or is the learner alone with the instructional material? The conclusion is that the context can be 'designed' in various ways, in order to impact how (strategies) and why (motivations) we choose to act in certain ways for learning.

4.4   Summarizing theoretical perspectives

Self-regulated learning (SRL) can be defined as learners exercising agency over their learning process by consciously monitoring their cognition, metacognition, emotion, motivation, behaviour, as well as the context (Azevedo et al., 2013; Pintrich, 2005; Zimmerman, 1989, 2005).   These concepts of what we need to monitor in the SRL process is often referred to as areas of SRL. Dividing SRL into areas is based on the notion that we can look at our learning from what we do (behaviour), how we think about what we are doing (cognition), and what we feel about what we are doing (affect and motivation). The part that self-regulation plays is seen as an important key to successful learning. It is the ability to monitor and control, that is to regulate and manage, these areas in various ways, and how, for instance, emotions play an important role in the choices we make for learning (e.g., Pintrich, 2000; 2005). Furthermore, this regulation has been shown to be related to contextual factors, such as assessment style (Richardson, 2000), and also something as simple as aesthetics (Norman, 2003; Peters, 2013). Therefore, context is also seen as an area that learners need to have the ability to regulate for their own benefit in the process of learning (Pintrich, 2005), and it is important for designers of learning technology to understand this regulation process in order to be able to design for it in the best possible way (Azevedo & Aleven, 2013; LeFrere, 2005; Peters, 2013).

In the Figure 14, the areas of SRL (cognition, affect, and behaviour) are illustrated as cogwheels that interact dynamically in relation to the contextual affordances. These affordances are aspects of the interface (e.g., interface aesthetics), the learning technology (e.g., accessibility), and part of the instructional design of the content to be

learned (e.g., activities). However, the lines between these three are often blurred, and therefore, the figure has no visual separation between the affordances of the context.

One perspective that SRL theories provide is to view SRL as a process, which can be separated into a number of phases. This perspective adds further insight into the learning process as such, and hence, gives important perspectives on what we can design for by targeting process phases specifically. Phases of SRL are often presented in forms of models. Although these models of SRL have both similarities and differences, the similarities are found in how the models describe SLR as a cyclical (Zimmerman, 1998) or iterative (Barnard-Brak, Lan & Paton, 2010) process, including a somewhat varying number of phases. According to most SRL theories, these phases of SRL follow a certain pattern, as depicted in the models discussed earlier. While comparing the variety of phases in SRL models, Puustinen and Pulkkinen (2001) conclude that three overall phases are prevalent: *preparatory phase, performance phase,* and *appraisal phase.*
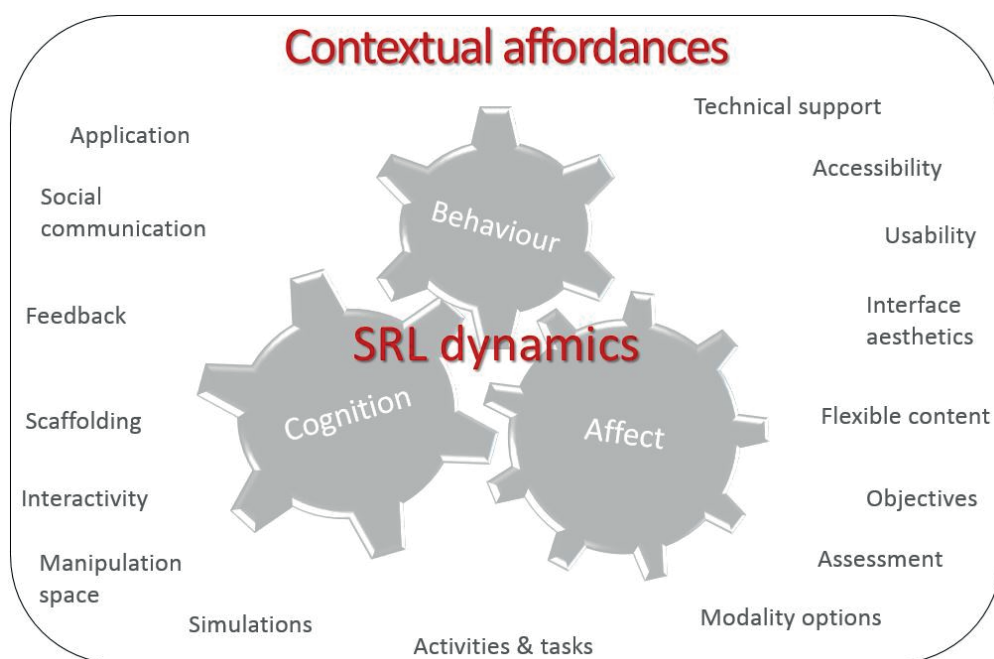
Figure 14 Examples of contextual affordances and the dynamic areas of SRL

However, a few models (e.g., Pintrich's, and Azevedo's) further separate between activities of monitoring and control in the performance phase. Monitoring implies the learner's awareness of cognition, emotion, behaviour, and context in relation to the task and what needs to be done in order to succeed. Control is the actual activation and actions taken in order to succeed; e.g., how one controls one's cognition in order to increase the prospects of success; how one controls one's emotions. The table below is an adaptation from Puustinen and Pulkkinen's (2001) illustrated comparison of the models and includes the models discussed so far in this theoretical compilation. The

original table illustrates the similarities of how the models describe the SRL process by three major phases. The new addition is the column of context, and the added models of Azevedo for hypermedia learning and of Efklideds for metacognition and affect in SRL. There seems to be no difference between the models regarding the phases of SRL in relation to context. However, the phases are merely categories on a generic level, or macro-level processes, as Azevedo and his colleagues (2004) have named them. These are, perhaps, less influenced by the context, as they pertain to basic human psychological functioning, whereas, the micro-level processes of SRL are more influenced by the affordances and constraints of the context. I argue that by paying attention to the essence of the latter especially, we will be able to identify the most important aspects of SRL in relation to context, and thus, learn how to better design for facilitating SRL. This research study is therefore targeting the micro-level processes of SRL.

Table 9 Comparing SRL models (adapted from Puustinen & Pulkkinen, 2001, p. 281)

Context	Author	Self-regulated learning process		
		Preparatory phase	Performance phase	Appraisal phase
Traditional learning	Pintrich	Forethought, planning, activation	Monitoring, control	Reaction, reflection
	Zimmerman	Forethought (task analysis, self-motivation)	Performance (self-control, self-observation)	Self-Reflection (Self-Judgement, Self-Reaction)
	Boekaerts	Identification, interpretation, primary & secondary appraisal, Goal setting	Goal striving	Performance feedback
	Winne & Hadwin	Task definition, Goal setting, planning	Applying tactics & strategies	Adapting metacognition
E-learning	Azevedo	Planning and goal setting, activation of perceptions and knowledge of the task, context, and the self in relation to task	Monitoring processes that represent metacognitive awareness of, as well as efforts to control and regulate different aspects of the self, task, and context	Various kinds of reactions and reflections on the self and the task and/or context
	Efklides	Task representation phase	Cognitive processing phase	Performance phase (e.g., self-observation)

Applicability of SRL theories for learning technology design

There has been a great interest in research on SRL since the 1970s-80s. Theories and theory derived models of SRL are still being developed (e.g., Boekaerts et al., 2005; Greene & Azevedo, 2009). It is a difficult task to embrace it all (Winne & Perry, 2005). The interesting question is rather how old models and theories are applicable to new technology-supported learning environments. For instance, Lee (2004) draws the conclusion that there is a danger in applying SRL-models of traditional face-to-face learning when considering new modes of learning using e-learning environments, and states that "research results imply that there would be limitations in supporting self-regulation in e-learning environments if we rely on solely the models and schemes based on face-to-face environments such as Zimmerman & Martinez-pons' and Pintrich & DeGroot's" (Lee, 2004, p. 5). Azevedo and Aleven (2013) highlight the importance of understanding the concept of self-regulated learning in relation to the ever growing number of various learning technologies:

> As a practical matter, the better we understand how learners learn with these technologies, and what challenges they encounter, the more likely it is that instructional designers and developers of technology-enhanced learning will create learning environments that benefit learners and help them learn better, instead of being just a cheaper delivery vehicle for 'old' instructional methods (Azevedo & Aleven, 2013, p. 2).

Learning technologies are becoming more widely used throughout society, and these technologies place an increased demand on learners' self-regulatory abilities (Aleven et al., 2010; Dettori, 2013). Tsai's (2009) literature investigation suggests that learners need to develop new approaches and cognitive strategies for successful learning in technology-enhanced learning environments. A review of 55 empirical studies on SRL in e-learning environments shows that these environments seem to work best for individuals who are already successful self-regulated learners. However, the review further reveals that SRL can be promoted in these kinds of learning environments (Bernacki et al., 2011). This is positive news, as other researchers have drawn the conclusion that the lack of support for SRL in corporate e-learning solutions might be the reason why many attempts of e-learning implementation have failed (LeFrere, 2005). Azevedo and Aleven (2013, p. 2) have high hopes that learning technologies will assist learners in becoming "better learners across domains by allowing them to acquire, internalize, share (with other human and nonhuman agents), and practice key metacognitive and self-regulatory skills". We still need more research in order to find out how we best can support learners in becoming successful self-regulators of their learning in technology-enhanced learning environments.

Not much research has been conducted on corporate e-learners' SRL, as most of the SRL research is conducted on students in primary education or at universities, although corporate e-learning is a rapidly growing business, and a potential economic goldmine. We live in a constantly changing world, in which knowledge usually has a best-before-

date (Siemens, 2005). The corporate sector is in high demand for quick and easy learning options for the life-long-learning of their work force, in an attempt to stay competitive in the market. The design of learning technology needs to scaffold learners in becoming self-regulated as a way to facilitate learning (Carneiro, 2005). This study aims to understand more about the dynamics of SRL by exploring the e-learning experience of corporate e-learners from a broad perspective, as research in the area of corporate e-learners' self-regulated learning is scarce.

5   Research question and targets

When a learner is faced with new learning technology, for instance, a computer-based learning environment, self-regulated learning (SRL) is about the learners' ability to meet the demands of the context, adapt their behaviour and choose actions that bring success in learning. Preferably, the environment in itself is the scaffold for developing as a self-regulated learner. The aim of this study is to understand more about SRL in the context of corporate e-learning, and specifically, how the design influences participants' actions and intentions for learning. The main research question that this study is aiming to answer is:

> *How does the design of the e-learning course influence participants' self-regulated learning actions and intentions?*

The table below illustrates the theoretical background of SRL discussed in the previous chapter in relation to this research question. These theoretically derived factors represent research targets presented in Table 10. Components of SRL are broken down into two descriptive dimensions: overt and covert SRL, as well as three areas of SRL: behaviour, cognition, and motivation/affect (Pintrich, 2005). These areas are correlated against the two course iterations subjected to study. Furthermore, the four atheoretical questions (how, why, where, and what) (Zimmerman, 1994) are used for highlighting the interdependence of perspectives to be targeted; the participants' actions (how) and intentions (why) are targets, which are assumed to vary depending on changes in the design of the e-learning context (where) and content (what).

Table 10 Framing research question in relation to theoretical background

Atheoretical Questions →		How? (Actions)		Why? (Intention)
	SRL / Course	Overt SRL	Covert SRL	
		Behaviour	Cognition	Affect & Motivation
What? (Content) **Where?** (Context)	Iteration 1			
	Iteration 2			

In accordance with the description of learning spaces (Chapter 2), both context and content are, in this research, seen as levels of the computer-based learning space, that is, the e-learning course. The iterations of the course do not differ with regard to content, only with regard to the design of the e-learning context. Therefore, the focus is placed on SRL versus the design of the course context, not the content (the course material to be learned). Furthermore, the e-learning context is represented by a complex interface

including many affordances and features. Therefore, this research looks at SRL in relation to any parts of the design – not only the changes made to the second iteration. The targets of SRL presented in the table are areas and dimensions of SRL discussed in theories and represented in the models. The idea is not to separate between these components in a superficial way, as these are more or less constantly interacting in the dynamics of learning. The idea is to be able to target SRL in a broad sense, without having to be bound to a specific model or theory. The how- and why-questions, from the atheoretical perspective on SRL, target learner actions and intentions. This can be interpreted as the strategies learners use, as well as their goal-direction and motivation. These questions reveal the dynamics of SRL, not merely the areas[32].

In this study, the how- and why-questions represent the core focus. However, the perspective of areas of SRL is valuable, as it offers a deeper interpretation of variations of micro-level processes of SRL. To illustrate this variation, the cells of the table above are further broken down into specific research targets, which can be traced to regulation of behaviour (how they behave and why), regulation of cognition (how they think and why), and regulation of affect (how they feel and why). These are listed in Table 11 and explained in the following.

Table 11 Research targets and questions versus areas of SRL

Research targets and questions	Areas of SRL
Behaviour: Overt e-learning management 1. *What are the observable differences in how participants, subjected to the two course iterations, take actions for learning and manage the course?*	Behaviour vs. content/context
Behaviour: Covert e-learning management 2. *Why and how do participants choose content and manage the context?*	Behaviour, cognition & motivation/affect vs. content/context
Cognition: Learning strategies 3. *Which kinds of cognitive learning strategies do participants use in their course work?*	Cognitive strategies vs. content/context
Cognition: Learning approaches 4. *How does the design of the course influence participants' cognitive learning approach?*	Cognitive approaches vs. content/context
Affect: Triggers and inhibitors of emotions 5. *What are the contextual triggers and inhibitors of positive and negative emotions experienced by participants of the e-learning course?*	Affect vs. content/context

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[32] Pintrich (2000; 2005) counteracts this by building a matrix of phases in relation to the areas.

Behavioural regulation

Overt e-learning management (actions): The first research target pertains to how behaviour is related to the course context and content. It is the visible actions of the learners; in other words, their behaviour for e-learning management. What I am interested in here is how participants are managing the content and context; *whether there are observable differences in how participants, subjected to the two course iterations, take actions for learning and manage the course.* However, to observe behaviour alone, only one area of SRL is covered.

Covert e-learning management (intentions): The second research target involves covert SRL. In contrast to overt SRL, covert SRL are the invisible actions. In other words, what goes on in a person's head while choosing content in order to learn something? This has to do with subjective choices related to overt SRL behaviour. Here, we are tapping into the intrinsic experience of the learner in terms of both cognition and motivation/affect as connected to behaviour and context. Therefore, this concerns the how-question in combination with the why-question, and all the areas of SRL are represented. I refer to this as covert SRL for e-learning management; *why and how participants choose content and manage the context.*

Cognitive regulation

Cognitive learning strategies (actions): The third research target involves cognitive learning strategies. Cognition is not always connected to visible actions. It also pertains to comprehension and the invisible, covert, part of the learning process. This part is related to the what-question; that is, the content and how learners use cognitive strategies in order to make sense of it; *which kinds of cognitive learning strategies participants use in their course work.*

Cognitive learning approaches (intentions): The fourth research target has to do with cognitive learning approaches, which involves how learners approach tasks depending on their perceived objectives of those tasks. With regard to cognition, research has continuously shown that instructional design and form of assessment influence the cognitive learning approach learners submit to (Biggs et al., 2001; Richardson, 2000). The cognitive learning approach is determined by intrinsic and extrinsic motivations for learning, and is, in that sense, the connection between our goal-directedness and the course design. Therefore, it is also of interest to this study to see *how the design of the course influences the participants' cognitive learning approach.*

Affective regulation

Experienced emotions and contextual triggers: The fifth research target concerns affect versus context. The concept of user experience in HCI refers to how the end-user is subjectively experiencing the digital context, and how it triggers and/or inhibits emotions.

This subjective experience is also connected to motivation, as user experience is deeply rooted in fundamental needs and goals as triggers of both actions and experiences (Hassenzahl, 2010). From a learning perspective, affective regulation is crucial for maintaining volitional control (Boekaerts & Cascallar, 2006; Deimann & Keller, 2006; Järvenoja & Järvelä, 2005; Kuhl, 1985). Although, affect and emotions are the least researched area within the field of SRL (e.g., Azevedo & Aleven, 2013). Hence, it is essential to understand *how contextual factors trigger and/or inhibit positive and negative emotions and how affective regulation can be supported*

6   Methods

In the previous chapters, various theories and definitions of self-regulated learning (SRL) were discussed and research questions were identified. Before I scrutinize the methods selected for the empirical study, I will discuss a variety of methods used in prior studies on SRL, and highlight their limitations and the critique against them. Each method represents a number of pros and cons. This presentation of methods is aimed to highlight the difference in perspectives on the subject that each method allows for, in order to set the frame for the choices made regarding methods in the present study, as well as choices for how data are treated, both during collection and analysis. Thereafter, the multiple methods, and designated research instruments of this study will be described in relation to the whole research design. I discuss these in terms of a mixed methods research design and outline the principles of the iterative steps of analysis.

6.1   Comparing measures of SRL

Methodology can be defined as the principles and epistemologically based thinking about how to conduct research within a specific field of study (Bjereld, Demker & Hinnfors, 2009). Hence, the research methodology chosen for a particular study guides the overall approach and layout. The research methodology involves the scientific paradigm framing the thinking of the researcher in relation to the subject of study. The results from a study are dependent on both choices of methodology and terminology (Creswell, 1998). How do we define, for instance, what SRL in the context of corporate e-learning is? And what are the best ways of conducting research on it?

Hodkinson and Macleod (2007) argue that specific research methodologies usually have strong affinities with different conceptualisations of learning. They found that ethnographic studies relate mostly to participatory views of learning, life history research relate to constructivist views of learning, and quantitative large scale survey research relates to learning as acquisition. They claim that it is difficult to investigate learning with a neutral lens, as the methodology might bias the findings towards a specific conception of learning. However, using more than one methodological approach might expose paradoxes and/or contradictions (Turner, 2001). In line with this, I will in the following, describe a variety of methods and argue for how the application of multiple methods is beneficial in investigating SRL in the context of e-learning.

There are a number of varied methods for investigating SRL. Winne and Perry (2005, p. 533) want to highlight the fact that "developers of measuring instruments must recognize they are operationally defining a theory of SRL in the instrument they develop". Each measure is based on a certain understanding of what SRL is and factors impacting the targets. Measures are based on models of SRL, and research feeds back to and tests the construct of the models. One way of categorising the measurement options is to separate those that measure SRL as an aptitude or those that measure SRL as an

event. This difference can be distinguished by exploring two main features of the measurement: the aggregation and the kind of information represented in the tools of measurement (Winne & Perry, 2005). Similarly, there are also two main paradigms for investigating learning in general (Entwistle, 1986). These two paradigms can be defined by the difference in their philosophically based epistemology. The first paradigm uses methods to collect quantitative data, and has a reductionist perspective focusing on predictions. The second paradigm represents an approach with roots in phenomenology focusing on the experiences of the learners, using an emphatic understanding of the meaning making of the learner (cf. Susimetsä, 2006). These two perspectives equal the distinction between measuring SRL as an aptitude versus exploring it as an event.

The utility of measurements differ, depending on the purpose of a study. Measurements can serve as description in basic research, serve as a tool for self-diagnoses for students, be used for informing an automatically adaptable learning environment (Winne & Perry, 2005, p. 561-2), or act as a feedback agent during iterative design of learning technology, as is the case in the present study (Wiklund-Engblom, 2007; 2008; 2009).

A selection of methods will be discussed in the following: self-report questionnaires, interviews, teacher judgments, think aloud, error detection tasks, trace methodologies, and observations of task execution (Winne & Perry, 2005; Zeidner, Boekaerts & Pintrich, 2005). Likewise, there are a number of methods for measuring SRL in e-learning. These are often based on the same models as methods for measuring SRL in traditional learning situations, and can also be categorised as those measuring SRL as an aptitude or an event.

6.1.1   Methods for measuring SRL as an aptitude

Self-report questionnaires

Two widely used protocols for measuring SRL as an aptitude are the two self-report questionnaires *Learning and Study Strategies Inventory* (LASSI) (Weinstein, Palmer & Schulte, 1987) and *Motivated Strategies for Learning Questionnaire* (MSLQ) (Pintrich et al., 1991). The MSLQ was described earlier in Chapter 3 as an example of differences in SRL in relation to context (see Table 7 and Table 8). These kinds of self-report questionnaires gather information about the memories of the learners, their interpretations of their actions, and also about the metacognitive and cognitive processes (Winne & Perry, 2005, p. 542-4). The questionnaires are based on Likert-scale self-ratings of statements relating to how students act, think, and feel in their learning.

Weinstein's work has involved the learning strategy development of college students, in which the focus has been to develop both students' awareness of and skills to use successful learning strategies. She developed the LASSI as a diagnostic tool for assessing strategic learning and its development process. The LASSI questionnaire includes ten different scales (Weinstein, et al., 1987):

1) Attitude and interest
2) Motivation, diligence, self-discipline, and willingness to work hard
3) Use of time management principles for academic tasks
4) Anxiety and worry about school performance
5) Concentration and attention to academic tasks
6) Information processing, acquiring knowledge and reasoning
7) Selecting main ideas and recognizing important information
8) Use of support techniques and materials
9) Self-testing, reviewing, and preparing for classes
10) Test strategies and preparing for tests

The LASSI was adapted for online learning as well, to which a new scale for communication was added, as this is an important feature for successful online learning. The MSLQ has also been adapted for online students to self-reflect on their learning process during online studies. One example of this is IQForm[33], which is a project for developing an intelligent tutoring system for assisting students at the Finnish Virtual University. Here, MSLQ is used together with other similar self-rating schedules in order to capture various perspectives of the learning process. The idea is, however, the same - measuring SRL as an aptitude.

A number of questionnaires for measuring SRL in computer-based environments have been developed during the past decade (Barnard-Brak et al., 2010; Shea, 2011; Tsai, 2009). These are based on the same theories of SRL as the traditional self-rating measurements described above. Tsai (2009) developed a questionnaire, the *Online Learning Strategies Scale* (OLSS), based on interviews pertaining to the concepts of skill, will, and self-regulation as defined by Weinstein (1994), but within the field of online learning. The OLSS consists of 20 items divided into five subscales:

1) Motivation
2) Self-monitoring
3) Internet literacy
4) Internet anxiety
5) Concentration

The motivation scale includes six items capturing a positive attitude towards online learning. However, it does not measure extrinsic motivation. Also one thing the author points out is that comprehension strategies were left out from the final version of the questionnaire. As such, the instrument is better aimed at measuring the overt self-regulation related to managing the e-learning environment than the covert self-regulation of adjusting and monitoring cognition as described by, for instance, Zimmerman (2005), Pintrich (2005), as well as Tessmer and Jonassen (1988).

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[33] http://iqform.it.helsinki.fi

Barnard-Brak and her colleagues (Barnard, Lan, To, Paton, Lai, 2009; Barnard-Brak et al., 2010) developed the *Online Self-Regulated Learning Questionnaire* (OSRL). It is a traditional self-report questionnaire for measuring SRL using scales of variables including: environment structuring, goal setting, time management, help seeking, task strategies, and self-evaluation. They used the OSRL instrument to identify five different profiles of SRL in online learning environments. They suggest that "the demarcations of theory presenting the development of self-regulated learning as cyclical or iterative process may have limited the mindscape of researchers, preventing them from considering profiles of types of self-regulation among learners as they develop these self-regulated learning skills and strategies" (Barnard-Brak, et al., 2010, p. 63). There is, however, an inherent paradox in the fact that they describe the OSRL as being based on the assumption that SRL is affected by context, but the OSRL is still a tool for generalising SRL within the whole field of online learning, not accounting for the contextual influences of any particular learning situation. OSRL is, such as the questionnaire mentioned above, measuring SRL as an aptitude. A self-report questionnaire is used for collecting data in the present study. At the time of the data collection, I could not find any questionnaires adapted for e-learning, and therefore, the LASSI and MSLQ were used for developing a new questionnaire adapted for e-learning, which will be described further ahead in this chapter.

Structured interviews

Structured interviews measure SRL as an aptitude, as far as they are prompting students to describe their learning based on memories of learning activities or discussing what they think are typical ways of learning in certain situations (Winne & Perry, 2005, p. 554). Zimmerman and Martinez-Pons (1986; 1988) developed a structured interview protocol called *Self-Regulated Learning Interview Schedule* (SRLIS) based on a range of theories focusing on concepts of the "self" in learning. Students were asked to visualize a set of fictitious tasks and describe how they would take actions for learning within these scenarios. The interview schedule is structured, as well as using specific follow-up prompts to direct the interview. The interview data are then analysed using three scoring procedures: 1) a dichotomous score of whether a student have discussed using a particular SRL-strategy from the predefined classes of SRL, 2) a frequency score of how many times a student said he/she would use a class of SRL, and 3) a consistency score describing how often a student would use a strategy he/she has mentioned. The scores are quantitative data used as predictors of, for instance, high and low achievers (Zimmerman & Martinez-Pons, 1986). This kind of analysis of interview data is not used to explore emergent aspects of SRL, but to find relations between aspects of the phenomenon that is already described in theories. The theory-derived categories of SRL that was examined in the above-mentioned-study were:

       1) Self-evaluation
       2) Organisation and transforming
       3) Goal setting and planning
       4) Seeking information

5) Keeping records and monitoring
6) Environmental structuring
7) Self-consequences
8) Rehearsing and memorising
9) Seeking help from peers
10) Seeking help from teachers
11) Seeking help from adults
12) Reviewing tests, notes and textbooks
13) Other

In the present study, interviewing was used as a technique to collect data. These interviews were thematically targeting both the themes of the questionnaire, as well as recorded actions using a video-stimulated recall protocol. This will be discussed further ahead.

Teacher judgments

The method of using teacher judgments is grounded in the assumption that teachers have the ability to assess their own students' use of SRL strategies. Zimmerman and Martinez-Pons (1988) created the *Rating Student Self-Regulated Learning Outcomes: A Teacher Scale* based on the same categories of SRL used in the SRLIS interview analysis. The data from teachers' assessments are then correlated to their students' self-ratings using the SRLIS. Hence, this measurement tool also regards SRL as an aptitude that can be measured as judgements of memories of actions and – in this case – another person's actions. In the present study, observation and interpretation of recorded learner actions are used. The interpretations of the observations were inductively done, and in that sense, different from the approach of Zimmerman and Martinez-Pons' (1988) teacher scale of students SRL. The observation technique used in this study is described further ahead.

Critique against measuring SRL as an aptitude

Researchers (Greene & Azevedo, 2010; Winne & Perry, 2005; Winne, 2010) are becoming critical about using self-report questionnaires for measuring SRL, simply because "they are based on students' often-inaccurate aggregate perceptions of their self-regulatory processes over numerous learning tasks". There is also a concern about there being "a fundamental disconnect between the assumptions inherent to models of SRL and self-report measures" (Greene & Azevedo, 2010, p. 204-5). Greene and Azevedo draw attention to this problem in a special issue of the Educational Psychologist (vol. 45, issue 4, 2010), which is dedicated to the measuring of SRL in computer-based learning environments. They highlight the importance of aligning theory and measurement of SRL. The key factor guiding the measurement should be the fact that SRL is a dynamic process, which is highly contextual, and therefore is adjusted according to the demands, affordances, and constraints of the context. Self-report measurements

are often administered before the students start the intended learning task, and students are furthermore asked to make judgements about their typical learning process, where the SRL process is then aggregated across an abstract number of tasks and assumed to be a static phenomenon. This is the fundamental base of the discrepancy between traditional measurement techniques and recent theory of SRL: a serious critique as such. Azevedo and his colleagues (Azevedo et al., 2013, p. 429) state that multiple measures need to be used to "detect, track and model learners' use of cognitive, affective and metacognitive (CAM) processes during learning". Problems related to mono-method biases stemming from too much reliance on questionnaires in research on SRL has been emphasized by Pintrich (2003) as well. Winne and Perry (2005, p. 559) express concerns about the lack of research on "how measurement interventions give rise to responses" when using self-rating questionnaires for measuring SRL. How can we, for instance, know whether a respondent is referring to his/her maximum ability or typical ability in responding to statements using Likert-scale measures? There is also another inherent assumption present in measuring SRL in e-learning contexts by using instruments that measure it as an aptitude guided by theories developed from traditional learning situations. The problem is the assumption that SRL in e-learning contexts involves the same cognitive, metacognitive, emotional, social, and contextually triggered actions and predefined strategies for learning as traditional SRL. What dimensions of the learning experience in one context might be missed by applying theories of learning from another context? One aim of the empirical study of the present thesis is to inductively explore e-learning experiences, in order to understand more about SRL of corporate e-learners. This will give hints on how traditional theories of SRL are applicable for measuring e-learners' SRL in this specific context. Questionnaires are used in the study, but for the purpose of supporting formative data.

6.1.2   Methods for measuring SRL as an event

In line with the critique discussed above, another assumption guiding measures of SRL is the assumption that SRL is a series of events/activities and a dynamic process. This assumption requires that SRL is measured and explored in real time, which is more in alignment with theories describing SRL (Winne & Perry, 2005; Greene & Azevedo, 2010; Winne, 2010). Measures guided by this assumption are designed to capture data about learners' monitoring and action control within a specific learning event and within a specific environment. Examples of such methods are, for instance, various think aloud protocols and stimulated recall interviews. These are important methods for the present study.

Computer-based learning environments easily lend themselves to an exploration of SRL as a dynamic process, as it is possible to gather data by using a range of technological tools capturing learner actions, reactions, and self-reflections. Azevedo, Moos, Johnson and Chauncey (2010) argue that trace methodologies need to be used for exploring the dynamic processes of SRL in order to understand the nature and frequency of the SRL processes, and for testing how current models can predict self-regulation in learning

situations: are they, for instance, cyclical, and if so, in what ways are they cyclical? (cf. Azevedo, Harley, Trevors, Duffy & Feyzi-Behnagh, 2013 on trace methodologies).

Think aloud and stimulated recall

Think aloud is a method when the student verbalises his/her cognitive processes during the time of study (Winne & Perry, 2005, p. 549). This is also referred to as *concurrent think aloud*, contrasting it to the *retrospective think aloud* procedure, which has a different impact on the learning process, as well as the research design (Tobii Technology, 2010). The retrospective think aloud procedure is different from the concurrent think aloud in the sense that there is no cognitive load experienced from verbalising the actions during the learning process. Verbalising the learning process during task execution has been found to impact the learning behaviour of the research subjects (Tobii Technology, 2009; Van den Haak, Jong & Schellens, 2003). Azevedo and his colleagues (2010) describe concurrent think aloud as a useful way of gathering data of SRL processes in online learning. However, they emphasize that the analysing process is both difficult and time consuming. Furthermore, the measurement of goals is usually difficult and produces incomplete or no data on a learner's goal generation. For retrospective think aloud in e-learning, the student is asked to verbalise his/her activities and thought patterns retrospectively, while watching the gaze pattern of the learning session recorded by an eye tracker. This process can further be executed using different levels of structured or unstructured interview protocols. Eye tracking is one of the methods used in this study and will be discussed more in detail in this chapter. The retrospective think aloud method is similar to a *Stimulated Recall Interview*, if a stimulus, such as a video or another recording of the event, is used for the think aloud. When using a Stimulated Recall Interview method, SRL may be construed either as an event or an aptitude, depending on the research design (Winne & Perry, 2005). In the present study, a Stimulated Recall Interview technique was used.

Error detection, trace methods, and observation

There are a few more methods of investigating SRL as an event that deserve mentioning: these are *Error Detection* tasks, *Trace Methods*, and *Observations* of task execution, as these, or variations of them, are important to this study. The method of error detection involves inducing errors into study material in order to see whether students notice the errors and what SRL actions these errors trigger. Error detection studies including recall measures have showed that the monitoring and control taking place during error detection sometimes works on a subconscious level when the student is not aware of the SRL process of repairing an error during the time of study (Baker, 1979; Winne & Perry, 2005), which makes this method somewhat unreliable if used alone, generating only observational data. Error detection as such is not used in this study. However, usability problems with the interface design can be regarded as contextual errors that influence learners' ability to manage the e-learning environment. Such problems may cause learners to compensate for, avoid, or miss important information.

Trace methods target observable indicators of SRL during task completion. Thus, traces are linked to specific models of cognition and SRL, and based on a pre-set understanding of how certain activities are to be categorised. Traces can be both unobtrusive and intrusive, depending on the level of instruction the students have received about monitoring their task engagement prior to task execution (Winne & Perry, 2005, p. 552-3). The eye tracker (e.g., Tobii) is a fairly new tool for assisting online trace methodologies, such as concurrent or retrospective think aloud procedures. Eye tracking is also an informative method for collecting observational data. Eye trackers have been around for a long time. However, new technology developments have enabled the method to become much more unobtrusive. This allows for better possibilities of using it for investigating the activities of, for instance, online learners (e.g., Azevedo et al., 2010). The data generated from the eye tracker visualises the learner's eye movements on the screen, as well as recording the screen activities. The assumption guiding this method is that a person's gaze is the key to his/her cognitive processes; what we see is what we are thinking about (Tobii Technology, 2010).

Observations of performance have certain strengths when it comes to measuring SRL. Observations reflect what students actually do in a specific context and task conditions can easily be accounted for. This kind of unobtrusive method might also be a better option for measuring young children's use of SRL. However, as observations do not reveal the cognitive (covert) processes related to actions for learning, it does not give the options of exploring cognitive or affective areas of SRL. By using only observation as a method, there is a risk of jumping to conclusions in categorising SRL activities, especially during observing computer-based learning where screen activities might not display much variety (Wiklund-Engblom, 2008; 2009). For a study such as the present one, variations of these methods serve as support in data analysis of the subjective formative data of interviews.

6.1.3   Suggestions for methods development for measuring SRL

As can be noted from the methods presentation above, there are a multitude of ways to investigate SRL. However, no single method or measurement technique is sufficient for providing a full picture of SRL (Greene & Azevedo, 2010, p. 206). This is also the base for the criticism directed against SRL research. In order to counteract the critique, and for developing and validating methods for investigating SRL, Winne and Perry (2005, p. 563-4) suggest that the following need to be done:
- Methods need to "characterize temporally unfolding patterns of engagement with tasks in terms of the tactics and strategies that constitute SRL";
- Methods are needed for comparing "patterns over time to reflect regulation per se"; and
- We need ways of triangulating methods that measure SRL as an aptitude with those measuring it as an event in order to "characterize the full spectrum of SRL".

Similarly to Greene and Azevedo (2010), Winne and Perry advocate triangulation of SRL measurement protocols in order to achieve a deeper understanding of models and methods to investigate the SRL models. However, the challenge lies in the commensurability of various levels of data and compatibility of rules for comparing measurements. That is, how data are measurable and comparable in accordance with a commonly agreed upon standard. We also need to learn more about developmental trajectories, as well as see how models of SRL fit across the age spectrum. The latter is one factor in the present study, as the target group is adult corporate e-learners, who have not been studied sufficiently with regard to SRL and its relation to how e-learning should be designed to support SRL (cf. LeFrere, 2005). Researchers (Azevedo & Aleven, 2013; Winne & Perry, 2005) express hope for the future development of new tools and ways of triangulating SRL measures within the field of learning technology design.

6.2 Research design

In the following, I will describe the research design of the present study, including the choice of methods and the procedures used for investigating the SRL of corporate e-learners. As discussed above, it is advantageous to use several methods for collecting various kinds of data in order to be able to investigate SRL more broadly as an event. This approach was applied in this study, which is common in formative research for iterative development of instructional design (Reigeluth, 1999), or in so-called educational design research (McKenney & Reeves, 2012). All instruments for collecting data are described in detail and presented in relation to the targeted areas of SRL. Focus is also placed on how methods and instruments are combined and used during the data collection process. The fundamental concept of mixed methods as a research approach is discussed. Mixed research is complex as it uses an iterative process of analysing the various data collected. This process and related terminology is explained here, as well as how the process of integrating data at various phases of both data collection and analysis was carried out.

6.2.1 A mixed methods approach

In this study, the point of departure from a methodological perspective was to try to approach the field of study in an open-minded manner with the ambition of overriding epistemological paradigms by bringing in several perspectives in using a variety of research methods (e.g., Turner, 2001; Volet, 2001). A mixed methods approach was chosen in order to see how different methods allowed for a varied exploration within the context of study. Mixed methods is the most common term for the blending of research methods and methodological paradigms in a study. Broader terms are mixed research or integrative research, which, according Johnson and Onwuegbuzie (2004), would provide a more inclusive meaning. Creswell and Plano Clark (2006, p. 5) refer to mixed methods research "as a research design with philosophical assumptions as well as quantitative and qualitative methods". Others argue that the minimum criterion for defining a research design as mixed is that there is an "interdependence of component

approaches during the analytic writing process" (Bazeley & Kemp, 2012, p. 70). The key is the integration of data at some phase of the analyzing process (ibid, 2012; Creswell, Clark, Gutmann & Hanson, 2003).

According to Repstad (1993), there are several benefits gained in research from combining qualitative and quantitative data collection methods. Qualitative interviews can be used, for instance, for improving questionnaire items. Or the other hand, a quick survey might give the researcher ideas on how to better focus interviews to target subtle matters. The latter is the case in this study. However, perhaps one of the most obvious benefits is that the researcher builds a more complex picture about the topic, and is thus more capable of drawing conclusions in the analysis. One aim of using mixed methods is to see in what ways traditional methods of quantitative measurements (cf. DiPaolo, 2001; Pintrich, 2005; Ruohotie, 2000; Susimetsä, 2006; Zimmerman, 2005) are able to target all areas of significance within the targeted research frame. For instance, the exploration of subjective experiences of the learners acts as a reliability check for how the theoretically derived measurements are valid in the new contextual circumstances of e-learning environments. This is a necessity, as this context may present new challenges for learners on many levels (cf. Järvelä et al., 2010).

Theories are partly used as background in this study, as the two questionnaires utilized are based on *a priori* hypothesis about areas and processes of SRL (e.g., Pintrich, 2000; 2005). The purpose of the mixed approach is to allow for exploratory research and the possible generation of new knowledge about the phenomenon of self-regulated learning in the context of self-paced, independent e-learning in a corporate setting; that is, it aims to generate *a posteriori* hypotheses about the phenomenon. Therefore, a number of methods are used for collecting formative data. In order to illustrate the complex overlapping between the sources of data, the next table lists how data sources are aimed at capturing research targets through the various research instruments and measures. Research targets emanate from theories of SRL and include the following areas in the left column: learning flexibility, motivation and affect, learning strategies, behaviour, context, and learning outcome. The mixed sources of data identified in the right column are: the pre-questionnaire Strategic Flexibility Questionnaire (SFQ), part I, II, III, and IV of the post-questionnaire Reflecting on E-learning Strategies Questionnaire (RESQUE), video-stimulated recall interview, screen recording (Group 1), eye tracking on the screen recordings (Group 2), psycho-physiological measures, and test scores. The research instruments listed in Table 12 will be described in detail further ahead.

The approach of mixing methods is seen as decreasing the potential weaknesses of any single method (Brannen, 2005; Johnson & Onwuegbuzie, 2004; Turner, 2001) or is a way to avoid a biased perspective due to methodological distortion (Hodkinson & Macleod, 2007). However, regarding studies on learning, Hodkinson and Macleod point out that a mixed methods approach does not fully solve the problem of a biased methodological perspective, as it derives from a philosophical dilemma, not an empirical one. The methodology might have a tendency to skew data towards a specific conception of

learning, but this need not be deterministic. They advise researchers using mixed methods to be aware of the conceptual and theoretical process this research approach will lead to.

Table 12 Describing relations between targets and sources of data

	Research targets	Mixed sources of data
Profile attributes	Perceived learning flexibility: - Adaptive - Irresolute - Inflexible	- Pre-questionnaire: SFQ
	Demographic information: - Age - Gender - Work experience - Nationality	- Post-questionnaire: RESQUE part iv - Video-stimulated recall interview
Areas of the SRL process	Motivation/affect: - Motivation - Attributions - Attitudes - Beliefs	- Post-questionnaire: RESQUE parts i/ii - Video-stimulated recall interview
	Perceived use of learning strategies: - E-learning context approach - Interaction & feedback - Effort regulation - Concentration - Identifying important information - Study aids & organisation - Elaboration - Critical thinking - Rehearsal & memorisation - Metacognitive self-regulation	- Post-questionnaire: RESQUE part iii - Video-stimulated recall interview
	Behaviour: - Learning actions	- Screen recording (Group 1) / eye tracking (Group 2) - Video-stimulated recall interview - (post) questionnaire: RESQUE; part iv - Psycho-physiological measures
	Context: - Course features	- (post) questionnaire: RESQUE part iv - Video-stimulated recall interview - Psycho-physiological measures - Eye tracking (Group 2)
Out-come	Learning outcome: - Self-assessments - Course final test	- (post) questionnaire: RESQUE part i - Video-stimulated recall interview - Test scores

As the purpose of mixed methods is to overcome the weaknesses of a single method in answering specific research questions, it calls for a pragmatic view on the choice of methods. It is inevitable that the fundamental principle guiding mixed research is to have a clear understanding of both strengths and weaknesses of, for instance, the methodologies and epistemologies of the two traditional paradigms, as well as insights

into analysing both qualitative and quantitative data (Johnson & Onwuegbuzie, 2004). This is perhaps one reason why mixed methods research is not so common, and has taken a long time to become recognised as a scientific research approach.

One key factor enabling a mixed methods research design was the inception of the user experience laboratory in 2003 at MediaCity, Åbo Akademi University. The lab is equipped for audience and content testing, and particularly used for evaluative studies during iterative design processes of digital content, similar to the e-learning course development of the present study. The aim of the lab is to be able to explore and measure end-users' experiences of digital content as authentically as possible. As the lab was new, the methods used there were in a trial phase. The study in itself was an exploration of the methods. Multiple methods were tried, in order to see what kinds of data would be generated, which perspectives could be explored concerning the research questions, and how different methods allowed for exploration within this particular context of learning technology. This approach can be compared to Paul Feyerabend's epistemological thesis that research paradigms need not be limited to a specific method, but rather explored with an open-minded attitude regarding research design (Molander, 2003). In studies on learning such an approach might be beneficial if one wants to conduct an explorative study without being tied to different paradigms of learning.

6.2.2 A process model for mixed methods research

One challenging factor in doing mixed methods research is to find a logical process for both collecting and analysing the data, and also for presenting the results. While mixed methods research always includes multiple sources of data, the process needs to clarify how and when different steps of data collection and analysis should be performed. This is clearly related to the kind of data and research questions of a study.

Johnson and Onwuegbuzie (2004) describe a process model which is flexible in the sense that the steps can vary in order, depending on the demands on the research design. The eight steps involve: 1) defining the research questions, 2) methods selection, 3) research design, 4) data collection, 5) analysis; 6) interpretation of data, 7) legitimation of data, and finally 8) writing up conclusions drawn from the study. The eight steps are illustrated by the round ovals in Figure 15. These are straightforward and similar to traditional steps of a single method research approach. However, the fifth step, data analysis, involves several iterations of data preparation and integration due to the multiple sources of data (e.g., reducing data, transforming, correlating, etc.) before the final interpretations are done. Separate data may be analysed in several phases, as well as analysed in integrated analysis of different sources of data. In the following, I will discuss the terminology used in the fifth step (data analysis) in order to clarify differences in treatment of mixed data during analysis, as these various treatments are significant to the present study.

Terminology of step 5: Data analysis

The black boxes in the figure illustrate the options of iterative steps for mixed data analysis. These represent alternatives for how to prepare and analyse different types of data. The terminology will be briefly defined at this point. However, the steps (of the black boxes) in the figure will be described more thoroughly in the section discussing principles of analysis used in the present study.

Data reduction, display, and transformation: Before mixed data are integrated, it is usually prepared and treated in order to be manageable. This is often done by reducing the dimensionality of the data in various ways. Data reduction may involve, for instance, exploratory thematic analysis (qualitative data), and descriptive statistics, factor analysis, or cluster analysis (quantitative data). Another way of treating data is to display data visually to obtain new perspectives. This might be done through the use of, for instance, matrices, charts, tables, or graphs (Johnson & Onwuegbuzie, 2004). Data display, is in that sense, also a type of data reduction. A third way is data transformation (ibid, 2004), also referred to as data conversion (Bazeley & Kemp, 2012), which involves converting qualitative data to quantitative in order to use it in a statistical analysis, or converting quantitative data to prose or narratives in order to be able to analyse it qualitatively.

Data integration: As mentioned earlier, data integration is the key in mixed research. The main purpose of data integration is to bring added value to the study by integrating various data sources "into either a coherent whole or two separate sets (i.e., qualitative and quantitative) of coherent wholes" (Johnson & Onwuegbuzie, 2004, p 22). The timing of integration varies from study to study. Usually, it is preferable if integration occurs early on in the analysing process, but if the study is to be considered a mixed method study, integration precedes the phase of drawing conclusions. It is preferable to plan for integration to be aligned with the aims of the study (Bazeley & Kemp, 2012). There are a number of principles of integration, and it can be done in many ways (ibid, 2012; Johnson & Onwuegbuzie, 2004). The terminology related to integration used in Figure 15 (data comparison, correlation, and consolidation) will be defined in the following, as these terms will be used to explain the iterative process of analysis of the empirical study.

Data comparison, correlation, and consolidation: Data comparison involves "comparing data from the qualitative and quantitative data sources", while data correlation takes it one step further as it involves "quantitative data being correlated with the qualitized data or the qualitative data being correlated with the quantitized data". Johnson and Onwuegbuzie (2004, p. 22) further mention data consolidation when "both quantitative and qualitative data are combined to create new or consolidated variables or data sets". Combining data sources involves using categorical or continuous variables in combination with qualitative data; for instance, text-based coded narratives. This might involve a combination of interview data and questionnaire data (Bazeley & Kemp, 2012). When using computer-based analysing tools, the integration of data in analysis can be

done through either combination or conversion, or both. A third alternative is when combination and conversion are used iteratively, which is likely to be used in "strategies such as data consolidation, blending or merging" (Bazeley, 2006, p. 66).
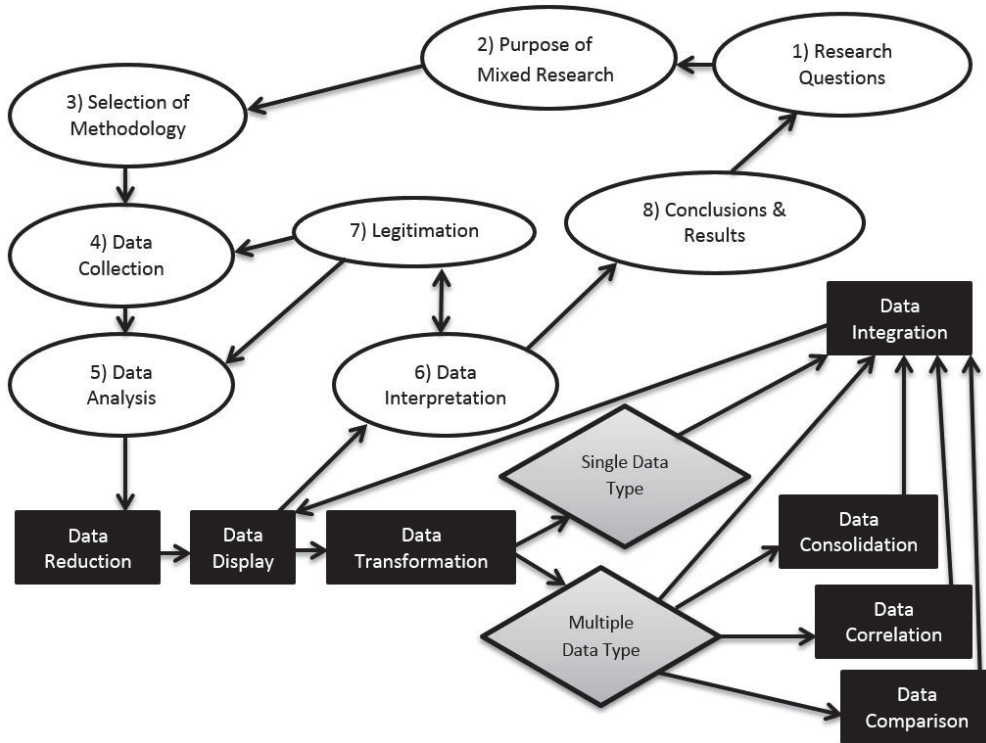
Figure 15 Research process (adapted from Johnson & Onwuegbuzie, 2004, p. 23).

Furthermore, *legitimation* (step 7 in Figure 15) plays an important role in the iterative process of analysis. It concerns "assessing the trustworthiness of both the qualitative and quantitative data and subsequent interpretations" (Johnson & Onwuegbuzie, 2004, p. 22), especially in relation to research questions. Legitimation is an ongoing process, which might include collecting more data, further analysis, and/or reinterpretation of data "until as many rival explanations as possible have been reduced or eliminated" (ibid, 2004, p. 22). In the present study, for instance, interview data were used for legitimizing analysis of observational data, which led to a more detailed categorisation of learner actions.

6.2.3   Overview of targets and data sources

In this section, the various research methods and instruments will be described in detail, as well as the steps of collecting data during the participants' course work. The multiple research methods used in this study were questionnaires, screen and video recordings, eye tracking, psycho-physiological measures, and interview. These methods, or data

sources, can be differentiated in various ways with regard to the kinds of data they generate. The matrix table below displays the variation of data collected in this study through the selected methods. The various types of data can be classified as objective formative (screen & video recordings, eye tracking), subjective formative (interview data), objective summative (psycho-physiological data) and subjective summative (questionnaire data).

Table 13 Data sources and types of data categorised

Types of data	Formative (qualitative) data	Summative (quantitative) data
Objective data	*How did they act?* *(Overt SRL)* Data sources: - Screen recording - Recorded eye tracks & focal points	*How did they react?* Data sources: - Skin conductance level (SCL) - Heart rate
Subjective data	*Why did they act?* *(Covert SRL)* Data source: - Video stimulated recall interview	*What are their attributes & attributions?* *(Outcome and self-assessment)* Data sources: - Pre-questionnaire - Post-questionnaire

Formative data are based on qualitative measures intended to explore topics, and mostly used for inductive reasoning. Summative data are based on quantitative measures intended for calculating and generalising, mostly through deductive reasoning. Subjective data are generated through data collection methods that allow participants' voices to be heard, for instance in interviews or in the use of questionnaires targeting attitudes, attributions and subjective evaluations. Contrary to this, objective data are generated through data collection methods that measure or record a situation as objectively and unbiased as possible, for instance, screen recordings, video recordings, eye tracking, or psycho-physiological responses, such as heart rate and skin conductance levels. As the matrix shows, all four kinds of data were collected in order to investigate the following aspects: how the participants acted within the course context, their reflections on why they acted as they did, and their reflections on their attributions, their personal background data (attributes), their attributions related to the course session, and how they reacted physiologically during their course work.

Multiple data as stimuli during interview

The mixing of methods was used already during the data collection process, as the interview was stimulated by screen recordings, eye tracking, questionnaire items, and psycho-physiological reactions. These stimuli can be distinguished from each other based on how they were used during the interview. The screen recording (for Group 1), and later on, the eye tracking data (for Group 2), were used as a direct stimulus for the

interview as in a video stimulated recall interview. The post-questionnaire (RESQUE) was used as a semi-direct stimulus, as the researcher used the structure of the questionnaire and the participants' replies as a base for discussing the course work (after the stimulated recall interview). The psycho-physiological measures were used indirectly, as the reactions were watched by the researcher during the participants' course work, and thus formed a base for the researcher's understanding of the session. However, these data were not referred to directly in the discussions during the interview. The table below illustrates the mix of data used in the stimulated recall interview.

Table 14 Data used as stimuli during interviews

Types of data	Formative (qualitative) data	Summative (quantitative) data
Objective data	**Direct data stimulus** - Screen recording - Recorded eye tracks & focal points	**Indirect data stimulus** - Skin conductance level (SCL) - Heart rate
Subjective data	Stimulated recall interview	**Semi-direct data stimulus** - Post-questionnaire

6.2.4 Instruments collecting formative data

To keep with the research design illustrated in the matrix above, I will continue to separate formative and summative research methods in the following description of the instruments. In order to frame the different learning experiences of the learners as closely as possible, several types of formative data were collected. The instruments employed for this purpose were stimulated recall interview, screen recordings, and eye tracking. A surveillance video camera was also used.

Stimulated recall interview

In this kind of educational design research aimed at the development of instructional design and design theories, the interview is the technique that usually provides the most useful data. Interviews allow for deep insights into participants' thinking and reactions in order to identify weaknesses of the design, as well as the strengths (Reigeluth & Frick, 1999). For this purpose we need interview questions that are both targeted as well as open-ended. The participants were subjected to a video stimulated recall interview after having filled out the post questionnaire (RESQUE). Reigeluth and Frick (1999) advise researchers to use video recordings as a recall tool, since it is often difficult for participants to remember details of the educational encounter. A video stimulated recall interview helps the participants trace back reflections and experiences of their learning process and such an interview technique is hence useful for the debriefing interview. The stimulated recall interview method is an introspective procedure in which the recordings of interaction stimulate recall of a research subject's concurrent cognitive

activity (Reitano, 2006), as well as his/her subjective experience pertaining to affect, including motivation and intentions. Hence, an instant recall interview method targets in-depth qualities of participants' experiences (Lyle, 2003).

The recordings of the laptop screen showing all overt activities and interactions of the participant's course work served as stimulus for recall of behaviour, thoughts, and emotions, as well as the context (cf. Pintrich, 2005; Zimmerman, 2005) during the participants' course work. According to Reigeluth and Frick (1999), the questions should focus on what hindered or helped learning within this particular instructional design, as well as on improvements that could be made. Suggested open-ended debriefing questions to be used after the participants' exposure to the learning solution are, for instance (Reigeluth & Frick, 1999, p. 641): "What did you like/not like about the elements of the design instance? What helped you? What did not help you? Did you feel the materials and activities were appropriate for your needs? What changes would you make? Did you feel that you obtained the targeted objectives?" The layout of the interview was semi-structured and based on the essence of the questions suggested by Reigeluth and Frick (1999) for improving course design.

The interview focused specifically on what participants had done during the course session, how they chose actions for learning, as well as their intentions behind these actions, that is, the why-question. Thus, the visible behaviour of the participant guided the interview. The purpose of the interview was to illuminate what a participant was thinking and feeling while interacting with the course, what influenced his choice of actions, how did he manage the course environment, and how did he reflect on his own intentions (why) and actions (how). Different problems that surfaced were discussed in detail, as well as possible improvements that could be made for making the course more user friendly and appealing for learners.

As the eye tracking camera was used for recording the screen for Group 2, the DVD recording became redundant. The eye tracker recorded everything that happened on the screen in addition to showing the participant's eye movements. It gave further information about what exactly a participant had been looking at on the screen and for how long. This made it possible to focus more on specific details on the screen. The validity and reliability of eye tracking-based recall interviews have been good in human computer-interaction (HCI) studies on end-user activities (Hyrskykari, Ovaska, Majaranta, Räihä & Lehtinen, 2008). Eye tracking-based recall interviews have also shown to provide more verbal data than traditional think-aloud methods (Guan, Lee, Cuddihy & Ramey, 2006).

The stimulated recall interview is similar to the technique of retrospective think aloud, where participants reflect on their actions while watching their eye movements after the actual task performance is over (Tobii Technology, 2009). However, the important difference is that the interview is guided in order to target specific research questions, rather than being a general open thought process by the participant.

Screen and video recordings

The screen of the laptop computer was recorded onto a DVD, for two reasons: 1) to collect objective formative data about participants' learning activities, and 2) to be used during the interview for stimulated recall of the experience of the learning activities. The participants were also filmed from above by a surveillance video camera in order to see whether there were body movements which could have caused the psycho-physiological equipment to record irrelevant reactions. By keeping an eye on the surveillance camera in the control room, any problems encountered by the participants could easily be detected by the researcher. Sometimes there were technical problems and/or participants became uncertain of what to do next.

Eye tracking

For the second group, while testing course iteration two, the lab had been upgraded with a TobiiX60 eye tracker and the recording software Tobii Studio. The eye tracker captures how participants interact with the content and how they focus their eyes on the screen during course work. Our eye movements can be categorised in two ways: fixation on something we are looking at, and the movements in between fixations, which are called saccades. The eye tracker records both fixations and saccades (Tobii Technology, 2009). This enables us to measure, for instance, the time spent in areas of interest, initial perception, and order of actions taken and fixations made within the media environment. Eye tracking as a research method is becoming more common in research on learning behaviour patterns, such as, for instance, research on cognitive styles for information management in online environments (Dogusoy & Cagiltay, 2009; Yecan & Cagiltay, 2006), visual mechanics of comprehension (Knight & Horsley, 2014), and self-regulation in online environments (Azevedo et al., 2010a, 2010b; Persaud & Eliot, 2014). Eye tracking data, that is, the eye movements or scan paths synchronized with the screen recording, were used for the stimulated recall interview for Group 2.

6.2.5   Instruments collecting summative data

The instruments utilized for collecting summative (quantitative) data were two questionnaires: the Strategic Flexibility Questionnaire (SFQ), and Reflecting on E-Learning Strategies Questionnaire (RESQUE). Psycho-physiological data, such as heart rate and skin conductance levels, was also collected, although these data were not used for analysis, only as indirect stimuli during data collection (cf. Table 14).

Strategic flexibility questionnaire (SFQ)

Filling in the Strategic Flexibility Questionnaire (SFQ) was the first thing the participants did after being introduced to the testing procedure. SFQ measures to what extent one thinks one is flexible within a learning situation and how one thinks one is able to adapt the way of learning between different learning situations/learning

environments. In other words, SFQ measures the learners' perceived ability for self-regulatory control in their learning processes. It shows the learner's inclination toward adaptive or maladaptive styles of executive control (Cantwell & Moore, 1996). SFQ uses a five-point Likert scale, and it consists of 21 items with statements for measuring three kinds of control: adaptive control, inflexible control, and irresolute control. These categories are the predetermined factors that Cantwell & Moore (1996) found in their sample. The *Adaptive control* category shows that the learner can adjust his/her study methods to accommodate different tasks. The *Inflexible control* category shows that the learner has a tendency to persist with habitual study methods regardless of their suitability for each new task. The *Irresolute control* category shows that the learner tends to experience difficulty in synthesising strategic options in the face of changing strategic demands. The purpose of using the SFQ was to see how the participants perceived and rated their own strategic adaptability to a new learning situation before taking the course, and whether there were differences between the two groups of learners.

Reflecting on e-learning strategies questionnaire (RESQUE)

After finishing the course session, the participant was relieved of the psycho-physiological sensors on his hand. Coffee and some sweets were served as a treat. Then the participant was asked to fill in the RESQUE questionnaire, which forced the participant to reflect on the strategies used while studying the course material. Despite an extensive search during 2001 and 2002, no questionnaire measuring learning strategies in an e-learning context was found. The two instruments that are the most widely used for research on self-regulation and study strategies are Motivation Strategies for Learning Questionnaire – MSLQ (Pintrich et al., 1991), and Learning and Study Strategies Inventory – LASSI (Weinstein et al., 1987). These two were used as a starting point for a new questionnaire, which was named Reflecting on E-Learning Strategies Questionnaire (RESQUE). Both Claire Ellen Weinstein and Wilbert McKeachie gave comments on the questionnaire during development. Finally, the RESQUE was further adapted to measure specific course features of the selected course. However, no large amount of data has been collected in order to validate the questionnaire. Furthermore, the population in the present study is too small for conducting valid statistical analysis. Thus, the RESQUE data are not used for quantitative analysis, only as a semi-direct stimulus during interviews. The RESQUE is built around three different themes: The learner's own self-assessment of learning and motivation within the e-learning environment, the use of learning strategies when taking the course, and an evaluation of various course features as facilitators of learning. The RESQUE is divided into six sections:
   1) Self-Assessment
   2) Your Motivation for E-Learning
   3) Your E-Learning Strategies
   4) Using Resource Options
   5) Your Feedback
   6) Background Information

These sections are further explained in the text below. Furthermore, the RESQUE uses a six-point Likert scale where only the extreme values are stated. In section one and four the extreme values are 1 = Very little; 6 = A lot. In section two and three the extreme values are 1 = Disagree; 6 = Agree.

Self-assessment: In the section for self-assessment, the participants assess their prior knowledge of the course content, their prior experiences of e-learning, how they felt in the learning situation, their motivation, how they felt they managed, as well as how well they learned the material and believe that they will be able to apply the new knowledge, and finally how much effort they put into it.

Your motivation for e-learning: The motivation for e-learning pertains to attitudes toward e-learning in general, engagement, satisfaction, frustration, and feelings of being confused by, or supported within, the learning environment.

Your e-learning strategies: The categories in the section about e-learning strategies are based on the strategies used in traditional learning situations. These have then been adapted to the specific situation of e-learning environments. The categories are: self-paced effort regulation, concentration, identifying important information, study aids and organisation, elaboration, critical thinking, rehearsal and memorisation, and metacognitive self-regulation (self-awareness of cognitive patterns and adaptability). It also assesses e-learning context approach, and thoughts about interaction and feedback.

Using resource options: The different features within the course layout are described as resource options. Here, the participants rate the options according to how they felt that these facilitated their learning. The resource options (e.g., static text, scroll down text, text with hyperlinks, static arrows, animated arrows) are listed separately, and are evaluated by the participants on a Likert scale showing only the extreme values of 1 = Very little; and 6 = A lot.

Your feedback: The test persons were given the option of writing openly about how they felt about the course, what they would like done to improve it, and also what kind of problems they encountered and what kind of help they would have needed.

Background information: Here, the participants list information about themselves, such as: work title, gender, year of birth, nationality, level of education, number of e-learning courses taken prior to this, performance score of the final test, minutes spent on the course, as well as reasons for taking the course.

Psycho-physiological measures

How the participants reacted, or rather responded, psychologically and physiologically during their course work was measured from both galvanic skin response data and heart rate using clip-on finger sensors. These measures generate objective summative data.

Our skin reacts to our emotional arousal by releasing moisture through our sweat glands. This can be measured very accurately on our hands, and is an objective measure as it is something we cannot influence consciously. Sensors placed on the fingers register changes in the electrical conductance of the skin that are driven by sympathetic or parasympathetic nervous system activation controlled by the brain. The sympathetic nervous system is activated when we have an emotional response or a stress response to stimuli. As opposed to this, parasympathetic activation means the subject is calm and has low stress levels. High skin conductance levels (SCL) indicate sympathetic activation and emotional response; low SCL indicate parasympathetic activation and low emotional stress levels. Our heart rate reacts to the same kind of psychological and physiological stimuli, but somewhat slower than SCL (Poh, Swenson & Picard, 2010).

Three sensors were placed on the participants' fingertips: two for measuring SCL and one for measuring the heart rate. Having sensors attached to one's fingers might be somewhat intrusive when working on a computer. However, the sensors were placed on the hand which a participant was not using for the laptop mouse. In the lab, SCL and heart rate data were transferred from the sensor to a computer and synchronized with eye tracking data and video recordings for the analysis. In this study psycho-physiological data were only used for observing participants' reactions during course work as an indication of a participant's level of calmness vs. frustration during the test session. However, this only had an indirect influence on the discussion during the interview, and the psycho-physiological data were not compared to other data for triangulation purposes.

6.2.6 Data collection

I have already touched upon the process of the data collection while describing the instruments. However, in the following the test population and the sessions in the lab will be described more thoroughly.

Test population

The criteria for the participants were that they were employees, or trainees in a large corporation, and that they would be a probable target group for this specific course content. Furthermore, it was significant that the participants were new to the context of e-learning environments, as one aim was to explore novices' development of e-learning strategies. Excluding the pilot study, the research population consisted of 18 male corporate employees; Group 1 (N=10) and Group 2 (N=8). Data from 17 of these were used in the analysis. The attempt was to gather a test population consisting of both men and women. However, this proved to be impossible, mainly due to the content of the targeted course, which was aimed at engineers. The mean age did not vary much between Group 1 [M = 34.5] and Group 2 [M = 35.6]. The titles of the research population included a wide range from managers on different levels and areas to engineers, designers, mechanics, and trainees. The ethnic backgrounds of the two

groups consisted of a mix of Swedish speaking Finns, Finnish speaking Finns, Dutch, and Indians. The test groups had an educational background of three levels: Vocational Education training, BA, or MA. The analysis using T-Tests of SFQ-variables, measuring their perceived flexibility of self-regulatory control in general in learning situations, showed that there was no difference between the two groups regarding the factors of perceived adaptability, inflexibility, or irresoluteness.

Lab testing

The data collection procedure consisted of 18 individual lab sessions conducted with the participants, plus one pilot study. Each session continued for approximately 3-4 hours. The order of steps of the lab procedure were: 1) introduction to the testing equipment and procedure 2) filling in the SFQ-questionnaire, 3) watching a music video while calibrating the instruments measuring psycho-physiological reactions, 4) completing the course work and the final test, 5) filling in the RESQUE-questionnaire while being served a treat (usually coffee and sweets), and finally, 6) the interview while watching the screen recordings as a stimulus for discussing the participant's activities within the course (a so-called video-stimulated recall interview). The five rows of the table below represent steps of the data collection process in a temporal sequence. Each step involves data collected using various methods and measures during a test session. This lab procedure is further explained here below.

Table 15 Steps of data collection during test sessions

Collection process	Data sources	Research targets
Step 1	SFQ	Perceived SRL flexibility and adaptability
Step 2	Screen recordings, heart rate, SCL	Learner actions during course session
Step 3	Learning outcome	Final test score
Step 4	RESQUE	Perceived use of SRL, course evaluation
Step 5	Stimulated recall interview	Discussing recorded actions, thoughts and reflections on how and why of learning activities

Introduction to the lab procedure

Each step of the procedure was described in detail to the participant at the arrival at the lab. This included a demonstration of all the equipment available (laptop, external mouse, printer, Internet access, pen and paper, plus an instructional print-out of the lab procedure), as well as ways of communicating with the researcher during the session, if needed. The participant further got an introduction to the technical equipment, including: 1) the psycho-physiological sensors (one sensor for measuring heart rate and two for measuring skin conductance), which were placed on one of the hands at this

point, 2) the surveillance camera overlooking the room, as well as 3) the screen-recording, which for the second group of participants included a Tobii eye-tracking camera. The participant was instructed that he was on his own, that the course was self-paced, independent learning, and that there were no time limits to his studies within the course in this lab situation, except for the final test, which had a 15 minutes time limit. The participant was encouraged to take his time to learn, and to study the material in the way that might work best for his own preferences for learning.

Calibrating instruments

Before starting the actual course work, each participant watched a short (3-4 minutes) music video. The purpose was to let the psycho-physiological measuring equipment become used to their response levels – a sort of time out for calming down and tuning in. Most of the participants watched Madonna's musical video "Frozen". However, there were some technical difficulties with the CD-slot of the laptop during a few sessions with participants of the first group. The Madonna video could not be used, and instead, the musical video of "The Ketchup Song" by LAS Ketchup was seen by these participants.

6.3   Principles of analysis

How data are analysed is guided by methodological principles based on the type of data collected. For the sake of clarity, the matrix of the research design (Table 13) presenting the four types of data will serve as a structure for discussing the principles of analysis. These will be discussed in relation to the iterative process of preparing different types of data, as well as the steps of both separate and integrated analysing. The model and terminology of Johnson and Onwuegbuzie (2004) (Figure 15) is used for describing the iterative steps of data preparation and analysis and elaborate on how these benefit and expand results.

Qualitative measurements for collecting formative data provide opportunities to explore the subject as an innovator searching for pieces of reality, in order to create a new understanding of it using inductive reasoning during analysis. It often includes a hermeneutically influenced process of interpretation. This is how the observational data were approached in this study. Similar to an inductive approach, abductive reasoning provides enough freedom to explore without limitations, while safety is found in mirroring the results in theories throughout the research journey. This is how the interview data were approached. However, as the iterative steps of analysing mixed methods often calls for several approaches to scientific reasoning, also the deductive reasoning approach has its place in this study, which was the case when the questionnaire data were analysed. The combination of these approaches is illustrated in the table below.

Table 16 Principles of analysis in relation to types of data

Types of data	Formative (qualitative) data	Summative (quantitative) data
Objective data	*Inductive reasoning* Data analysis: - Interpretation - Explorative categorisation	
Subjective data	*Abductive reasoning* Data analysis: - Interpretation & meaning condensation - Iterative thematic categorisation - Recategorisation	*Deductive reasoning* Data analysis: T-test of SFQ-factors

6.3.1 Formative data

The formative data discussed here comprise both observational and interview data. The principles of analysis used are described and also summarized in a table presenting the iterative steps of analysis.

Objective formative data from observations

Visible activities, also representing the participants' overt self-regulation, were analysed by using observational data (objective formative) of screen recordings and eye tracking. Inductive reasoning is based on the epistemological belief that all science starts from observing. Inductive reasoning grows out of multiple experiences within a specific reality and is probabilistic in nature. Probable conclusions are drawn from observations of reality within this chosen context, as well as based on a certain ontological perspective of the context (Flick, 2002). No comprehensive theory for induction exists, and the probabilistic nature of induction opens up for the possibility that the conclusions drawn may be false (Vickers, 2012). In the present research study, probable conclusions drawn at an early phase of analysis are well suited for the iterative steps of mixed data analysis. Conclusions drawn from one set of data may be validated by other data sets in the iterative process of analysis.

Familiarization with observational data was done through repeated viewing of the screen recordings simultaneously with the psycho-physiological data for each screen. For the second group, eye tracking replaced the DVD-based screen recordings (cf. Nyström, 2007). The synchronisation of data was made possible by the eValue8 analysing software developed at the MediaCity lab. This process of familiarization can be compared to the phase of naïve listening in a hermeneutic analysis of interview recordings. During this phase, the observational data were watched as a whole in order to form a naïve understanding of how the participants managed the e-learning environment in order to

complete the course. This naïve understanding and early thematic categorisation of learning management behaviour formed the base for further categorisation of interview data (cf. Lindseth & Norberg, 2004). The observational data of participants' course activities represent one perspective of "the truth" about their learning. The observations gave rise to a preliminary interpretation of how the participants used different strategies for managing the e-learning environment in order to learn. This interpretation and categorisation of learning behaviour resulted in an activity-based typology of management strategies (Wiklund-Engblom, 2007). Interpretation of data is usually referred to as a hermeneutic approach. Interpretations are always human constructions, which are influenced by context and traditions. Therefore, a specific interpretation is only meaningful to the extent to which it deepens understanding of the data. There is never only one single truth out there. Multiple models for explaining a phenomenon might be preferable (Nyström, 2007).

While analysis of the data from observations gave an idea of how the participants managed the environment as such, and their needs on a more technical level, it revealed nothing about their inner world (Wiklund-Engblom, 2007). On the contrary, interpreting their affective and cognitive presence based on observations would be nothing more than a guess based on the researcher's own projections. Therefore, it is inevitable that interviews are essential for investigating critical aspects of participants' learning, especially their covert strategies of SRL. We cannot know what someone's learning experiences are like unless we ask them (Marton & Booth, 1997). A second phase of transforming the observational data was bookmarking screens for the participants' time spent on each screen. This was also done with the eValue8 software. A third phase included transcribing the observational recordings into short descriptions of user activities related to each screen. Then inductive interpretations about their overt SRL were made based on these descriptions of activities. Both descriptions and interpretations were organised in accordance with each screen in a worksheet for comparison and integrated analysis. In this worksheet, screens, related screen activities, and observational interpretations were compared to interview transcripts and the meaning condensations of the interview material. This will be described further ahead.

The treatment and thematic categorisation of the observational data was inductive in its approach and resulted in categories of e-learning management. This approach is supported by the process of hermeneutic analysis, in which the key is that the meanings found in data are the base for the results of the study – not theories. Theories are merely utilised to shed light on possibilities for understanding data in new ways. On the contrary, as Nyström (2007) points out, we should become suspicious if interpretations of data are too similar to existing theories. This is one reason why theories should be regarded at a late stage in a hermeneutic study. The screen recordings, including the traces of eye movements, were used for qualitative descriptions and interpretations. Quantitative analysis of eye tracking data is possible by comparing measures of fixations and saccades in areas of interest, mouse clicks, time, etc. However, quantitative analysis of eye tracking data was not employed in the present study.

Mixed analysis work sheet of formative data: For each participant, a mixed analysis worksheet of the formative data collected was made. The purpose of this data consolidation was to organise data and create an overview as a foundation for comparison and analysis. The structure of the worksheet is presented in Table 17.

Table 17 Example of a mixed analysis work sheet

1. Screen thumbnails	2. Interview transcript	3. Meaning condensation of interview	4. Narrative of actions from screen recordings	5. Interpretation of actions
Screen 1	…	…	…	…
Screen 2	…	…	…	…
/…/	…	…	…	…
Final test	…	…	…	…

The mixed analysis work sheet included: 1) screen shots of all 24 content pages, 2) interview transcripts, 3) interview interpretations through meaning condensation, 4) narrative of course work based on observations of screen recordings, and 5) interpretations of these observed actions in terms of strategies used. Hence, both types of formative data and subsequent interpretations were lined up for each screen, in order to obtain an overview of their learning process as a sequence from start to finish. This was an intuitive way to organise and display data, since the interview discussions were stimulated by the screen recordings of what each participant had done during their course work. The mixed analysis worksheet was therefore a tool for organising, synthesising, and consolidating data for further iterative steps of analysis. It was a natural step of triangulating data and cross-validating the preliminary findings from the first steps of analysis (examples of meaning condensation of interviews and narratives of actions from screen recordings are found in Table 20-27).

Subjective formative data from interviews

A video stimulated recall interview using semi-structured questions relating to the participants' learning experience was conducted after each course session. Interviews generate subjective formative data by especially targeting the general question of *Why did they act?* (cf. Table 13). Abductive reasoning was the logic used for this set of data, as it was both opening up for new knowledge and at the same time allowed checking the data against prior theories and ways of categorising self-regulated learning. The main idea behind abduction is to achieve an attitude of being prepared to let go of old convictions, as well as having the attitude of openness towards new conclusions (Reichertz, 2004). Familiarization with interview data was done through repeated listening to the interviews, as well as transcribing them word for word. A hermeneutic analysing process is usually structured in the steps of interviewing, naïve reading, structured analysis, comparisons, and holistic interpretations. During the phase of naïve reading, the researcher creates a preliminary understanding of the whole, before stepping into the interpretation of parts and pieces. Parallel to this is the process of

viewing the preliminary whole in relation to own preconceptions of the phenomenon (Lindseth & Norberg, 2004; Nyström, 2007).

The interviews focused on what the participants did and discussed the why and how of their learning in relation to how the environment facilitated their course work. In hermeneutic interpretation one is searching for meaning from clues answering the questions how and why. It is a process of reading between the lines in order to unveil the existential meaning hidden in, for instance, how people describe a specific phenomenon (Lindseth & Norberg, 2004; Nyström, 2007). One research target was the context of learning, and more specifically, to see how the e-learning environment facilitated SRL. This learning facilitation was reflected in the needs discussed by the participants. Based on repeatedly listening to, transcribing and reading the transcripts of the interviews, a first broad categorisation of six primary needs was created: basic needs, affective needs, context management needs, cognitive needs, application needs, and acknowledgement needs. These needs seemed to span through the course work and relate to the learning process as such. In the next phase, the transcripts were organised in accordance with each screen in a mixed analysis worksheet. Meaning condensations (Kvale, 1997) were then made for each statement, in order to find the essence of all conversations pertaining to each screen and the participants' interactions with it. This is a data reduction process, as the units of analysis are condensed.

NVivo coding procedure: The following step was to code interviews in the QSR NVivo software. NVivo is a well-suited computer programme for approaching qualitative data inductively. It allows for unlimited building of categories and subcategories that are either hierarchically or horizontally related, and also to endlessly manipulate structures of categories until one feels that the data are saturated (Bazeley, 2007). In NVivo, a first structure of categories for the interview data was made based on both the thematic categories from observations of participants' course work (overt SRL), as well as the thematic categories of the participants' most recurring discussion theme during their interviews (covert SRL). Although meaning condensations had been made already in the mixed analysis work sheet of formative data, the original interview statements were used for coding in NVivo. The preliminary thematic categories were used as starting point for categorising the original interview text. The material was worked with inductively for exploring the data, and re-categorised several times, using methods of comparison of variation, as well as grouping of similar categories and sub-categories. The various groups were labelled and organised in primary categories and sub-categories.

One outcome of the recategorisation was a new category called Choice of Content. This category included 111 statements of the participants' discussions on choice of content in their course work. During the analysis that followed, each chosen statement was compared to the meaning condensation done earlier in the mixed analysis work sheet. The 111 statements were subjected to the how- and why-questions, in order to interpret the intentions (why) behind their choices, as well as their actions (how) to manage in their course work. This was attempted in order to find the essence of each statement

targeting the research questions. Finally, the categories were labelled and contrasted for similarities and differences. The variations in the statements pertaining to Choice of Content resulted in five primary categories, including 15 subcategories altogether. These results are presented in the next chapter.

Table 18 Iterative steps of analysing formative data

Iterative steps of analysis		Screen observations		Interview data
Data preparation	- -	Repeated naïve watching Bookmarking screens	-	Repeated naïve listening
Data transformation	- -	Creating a visual narrative Narrating overt activities	-	Transcription
Data reduction	-	Explorative categorisation	- - - - - -	Meaning condensations Thematic categorisation Explorative categorisation Recategorisation Comparison of variation Grouping of similar categories
Data integration			-	Iterative categorisation in accordance with observational categorisation of overt activities
Data comparison	-	Integrated with interview transcripts	-	Integrated with screen recordings
Data consolidation	-	Mixed analysis work sheet	-	Mixed analysis work sheet

The interviews were carried out in either Swedish or English. English was a second language to all participants. The excerpts used in this thesis have been transcribed and translated by the researcher. Minor grammatical errors were corrected with careful considerations to the meanings of the content.

6.3.2   Summative data

The summative data include pre- and post-questionnaire data, as well as psycho-physiological data from skin conductance levels and heart rate.

Subjective summative data from questionnaires

Quantitative measures, such as the two questionnaires used in the present study, are usually analysed using deductive reasoning as questionnaire items derive from theories of SRL and prior research (cf. Winne & Perry, 2005). In deductive research, *a priori* hypothesis are formed, for instance, for testing a theory in various contexts. Conclusions drawn need to be valid, reliable, and generalizable. This is a stark contrast to the probabilistic conclusions of the inductive research approach (Vickers, 2012). Due to the small sample in this study, there is no intention of forming any generalizable conclusions based on quantitative data. As the RESQUE questionnaire had not been

validated in any larger study, no comparison of group differences is presented here. Therefore, the post-questionnaire data were not analysed, but merely used as a source for reflection during interviews. However, the data from the pre-questionnaire, SFQ, was analysed using T-tests, in order to see whether there were any group differences with regard to the participants' perceived learning flexibility and adaptability (cf. Cantwell & Moore, 1996).

Objective summative data from psycho-physiological measures

The psycho-physiological measures collected data from participants' heart rate and skin conductance levels. These data were not used in the analysis, as these measures did not particularly pertain to the research questions. Psycho-physiological data were only used for observing participants' reactions during course work, as an indication of his level of calmness versus frustration, which indirectly influenced the discussion during the interview. The psycho-physiological data were also used in synchronisation with observational data of screen recordings during the phase of naïve watching, using the eValu8 software[34]. However, the data were not used separately for analysing learner activities, as the interviews were not linked with the reactions as stimuli for the discussion. However, this would be possible using another set up and research design.

6.4   Trustworthiness of research measures

The purpose of research is to examine reality for us to be able to understand and predict aspects of it. Numerous perspectives can be used when selecting what to examine and how to examine it in the most accurate way. The potential trustworthiness of research measures therefore need to be scrutinized. The most common terms to describe trustworthiness are validity and reliability. However, these are derived from a positivist paradigm of research and are not equally applicable within other methodological paradigms. In quantitative approaches, grounded in a positivist research paradigm, *validity* is defined as the ability a measure has to accurately target the broader construct under investigation in the way it was intended. It can be defined as construct validity and accuracy of framing the research question and hypothesis posed. This is also referred to as internal validity, while external validity concerns generalizability across contexts (Hoepfl, 1997). The concept of *reliability* refers to how measures are stable and consistent over time. It can be defined as the replicability and stability of measuring the same construct in the same way at different times (Golafshani, 2003).

In research using a qualitative research approach, the concepts of validity and reliability are somewhat controversial, although they are generally used in all sorts of research studies. However, the way these concepts are used for examining the trustworthiness of positivistic research is not applicable in a qualitative context. For instance, replicability is not an aimed for outcome when qualitative data are collected, but rather to see how

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[34] eValu8 is software developed at MediaCity for data visualisation, synchronisation, and mixed analysis.

the findings can be considered as credible and transferable. The qualitative approach seeks to understand and illuminate instead of predict or generalise, and hence the concept of trustworthiness takes on a different meaning in the way it is applied (Golafshani, 2003). As a replacement for internal validity, the term *credibility* refers to how the qualitative data collected are able to adequately represent potential multiple realities. Thus, it is the richness of data that determines the credibility, rather than a large sample size (Hoepfl, 1997). In order to enhance credibility, *triangulation* can be used as a verification against error in the research process (Yin, 2003). Yin (2003) uses the term triangulation when there are multiple sources for collecting information, and where the data collection through every source is aimed at corroborating (confirming and verifying) the same phenomenon and answering the same research question. True triangulation is when a stated fact of a case is supported by more than a single source of evidence. However, it is possible to use many sources of data without applying triangulation. This is done when the data from different sources is separately analysed, and only the conclusions are compared, i.e., the integration phase is omitted during analysis (cf. Bazeley & Kemp, 2012; Creswell et al., 2003). The most common techniques of triangulation in collecting formative data for instructional development are observations, interviews, and documents (Reigeluth & Frick, 1999). Two different forms of triangulation are present in this study: *methodological triangulation*, as multiple methods are used to collect data (in this process methods are even used iteratively in the data collection process, when one source of data forms the base for collecting another source, as in the video-stimulated recall interview), and *data triangulation*, as sources of data are cross-validated against each other during analysis (Yin, 2003). I interpret this as being similar to what others define as integration of data during iterative steps of analysis described in mixed research (Bazeley, 2006; Bazeley & Kemp, 2012; Johnson & Onwuegbuzie, 2004).

Another term describing the trustworthiness of the naturalistic approach using qualitative data analysis is *transferability*. It is the corresponding term to the concept of generalizability of quantitative analysis, and is thus concerned with the external validity of the study. Even generalisations drawn from quantitative analysis are merely hypotheses – not conclusions, as context is a factor that always needs to be considered (Hoepfl, 1997; cf. Cronbach, 1975). While using qualitative data, the quality and richness of data are, again, the means for determining how transferable the results of a study are to another context. In a qualitative context, *dependability* is used as a corresponding term to reliability (Golafshani, 2003; Hoepfl, 1997). This is similar to verifying the consistency of data through the principles of analysis that ensures the dependability of both the product and the process of analysis. Examples of this are providing raw data, reductions of data, and evidence of the analysing process (Campbell, 1996; Golafshani, 2003).

7 Case description

In educational design research, a baseline is identified as the platform to work from in making changes to the design. In this chapter, the selected e-learning course is depicted with regard to the phases of development and the changes made in the educational design of the second course iterations. It is a brief overview of the course subjected to study, and how it was changed based on the participants' feedback. Furthermore, two narratives of two participants' course work (one participant from each group) are included, in order to illustrate examples of learning actions and e-learning context management from an observational perspective. However, I begin by explaining the background to how this particular course was selected and why.

7.1 Background

Between 2001 and 2003 I was involved in several e-learning development projects in the industry. My aim was to obtain permission to do research on one course, since I was interested in the users' experiences from a pedagogical perspective, and how this could guide the design process to better correspond to the needs of e-learners. Thus, my ulterior motive was to find a research object. However, it proved to be rather difficult to obtain permission to conduct research on the courses being developed due to a number of reasons, such as time constraints, database privacy restrictions, etc. However, finally, after a two year search, I was given a selection of demo versions of self-paced e-learning courses, which were being developed for a large international company. Out of nearly a dozen, one course was selected based on its length and content. It was short enough to be able to go through in 30-60 minutes, which would allow me to record the whole learning process, as well as use the recorded material in an instant recall interview with each individual after the learning session was over. The course further showed most variation regarding content in comparison to the other options. This would allow me to focus on a variety of different features within the course content, while exploring how the participants managed the environment and how their learning processes were influenced.

I was invited to take part in the development process and give feedback to the course designers on pedagogical issues in relation to the interface- and instructional design. This feedback was used to make changes to the e-learning environment (although not to the course content), which resulted in a second iteration of the course. Therefore, this research study was done in two phases of testing, in which two iterations of the same course were used (the first iteration was tested in 2003, and the second in 2004). Although the usability (ease of use and functionality of the learning environment regarding the interface design) was a factor that was discussed with the participants during the interviews after each learning session, the actual research interest I had was to find out about their more subjective learning experience; their choices and actions for learning, as well as their own perceived learning needs. In the following description of

the e-learning course, I will first focus on usability issues, such as navigational instructions and interface design, and how these were changed based on the feedback from the first group of participants. Thereafter, narratives of two different participants' course work are presented.

7.2 Iterations of educational design

In accordance with the two aims of educational design research, the design aim of the study (the improvement of the course design) is secondary to the theoretical aim, which in this case is the investigation of the learners' SRL (cf. McKenney & Reeves, 2012). However, these two perspectives still represent two sides of the same coin, as the context is one important factor influencing our SRL (e.g., Bandura, 1986; Järvelä & Niemivirta, 2001; Turner, 2001; Volet, 2001; Zimmerman, 1989; 2005) as it frames our experiences of a situation (e.g., Hassenzahl, 2010). In educational design research, there are three core phases, which provide a flexible and iterative structure to a study: investigation/analysis, design/prototyping, and evaluation/retrospection (McKenney & Reeves, 2012). These phases are presented in Table 19 and short descriptions of the various phases of the course development and iterative design is provided, in order to explain the process further.

Table 19 Phases of testing and iterative course design

Phases	Process of development and testing
1) Investigation/Analysis	- Pilot study (N=1)
	- Testing first course iteration (N=10)
	- Identification of problems
2) Design/Prototyping	- Feedback to course designer
	- Course improvements based on feedback
3) Evaluation/Retrospection	- Testing second course iteration (N=8)
	- Summarizing evaluations of e-learning experiences to course designer

Phase 1) Investigation/Analysis

During the first phase of testing the e-learning course (first iteration), a demo version of the course was used. This was conducted in order to gain a baseline understanding of how the participants managed their learning in this learning context. The phase involves a thorough identification and diagnosis of problems that can be improved by redesigning the affordances of the context itself (McKenney & Reeves, 2012). This diagnosis was based on both the participants' course interactions and reflections, as well as my own background and theoretical understanding of e-learners' needs for SRL. Firstly, a pilot study was conducted in order to see that all the research instruments and technical lab equipment worked, and that the selection of research methods and

instruments were adequate and satisfactory. Secondly, individual test sessions were conducted with ten participants.

Phase 2) Design/Prototyping

Conclusions were drawn from observing participants' course work in the first iteration of the course, as well as from interviewing them about their learning reflections. Several problems of the context were identified, which interfered with and hindered participants' management of their learning. These were discussed with the course designer, both with regard to actual behaviour of the participants, as well as a theoretical anchoring of the problems encountered. This resulted in improvements of the layout and instructional design of the e-learning environment. The most important change was how feedback was provided both during the practice section and in the final test. These changes and other course design details are discussed more thoroughly in the section below describing the e-learning course.

Phase 3) Evaluation/Retrospection

The second iteration of the e-learning course was then tested on a new group of eight participants. The final phase consisted of summarizing the evaluations of the experiences expressed by the participants as final feedback to the course designer, so that this understanding could be implemented in future course design. This was done in 2004. However, the write-up of the analysis pertaining to the theoretical perspective of educational design research is presented in this thesis. In the following, I will describe the e-learning course in more detail and discuss the identified problems, as well as the changes made to the second iteration.

7.3   The e-learning course

The course under investigation is divided into six modules: (1) Overview/Introduction, (2) Description of the Solution, (3) Technical Background, (4) Product Description 1, (5) Product Description 2, and (6) Sales. There are 24 main screens of course content in total, with the addition of several links to external documents within these 24 screens (see Appendices). In addition to these 24 screens are practice options for all the modules. Thumbnail images of screen shots of all 24 screens are presented with the two narratives at the end of this chapter. As the course testing was conducted at the MediaCity lab, which is not linked to the intranet of the corporation, some features related to the learning management system[35] were unavailable in the off-line mode of the course. However, this did not make any difference for the learning experiences of the test groups. The main language of the course was English. However, there were a few links to external documents that were written in Italian.

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[35] A Learning Management System (LMS) is a software system for managing and delivering e-learning courses.

Menu screen

In the first course iteration, the first screen had three important features: a brief introduction of the course content, a section listing what the participants will learn, and a navigation menu for the six modules plus the final test. When the participants had gone through a module, a green marker was placed on the right side of that module button, in order to show how much they had completed thus far. In the image below, the green marker shows that the user has completed the first module: the Overview.
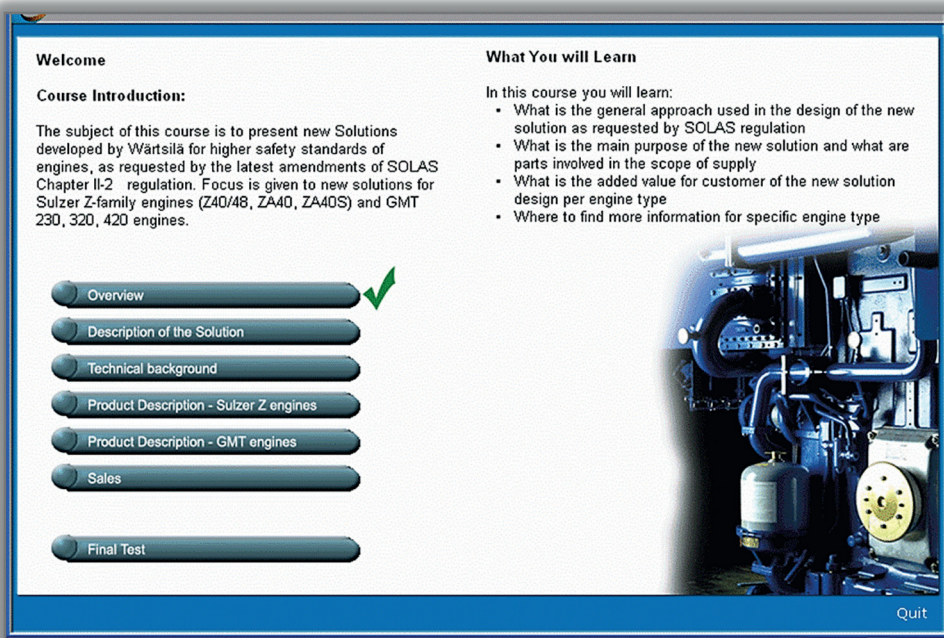
Image 1 Screen shot of course introduction page for iteration 1.

In the second iteration, an additional column of menu buttons, called Your Resources, was added next to the Course Menu (see image 2). This resource menu included: Course Map, Printable Version, Learning Instructions, Frequently Asked Questions, Links & Documents, and Feedback (an option to give their own feedback to the course providers). The Course Map was the only resource that actually worked offline and had been programmed at that point. However, I had printed the Printable Version of the course (including all 24 screens), as well as the Learning Instructions for Group 2. These documents were introduced and described briefly to each participant of that group, and they had the option of looking at them at any time while taking the course. The participants in Group 1 had further requested an indication of the estimated time for completing the course. This information was added to the Menu screen in the second iteration.
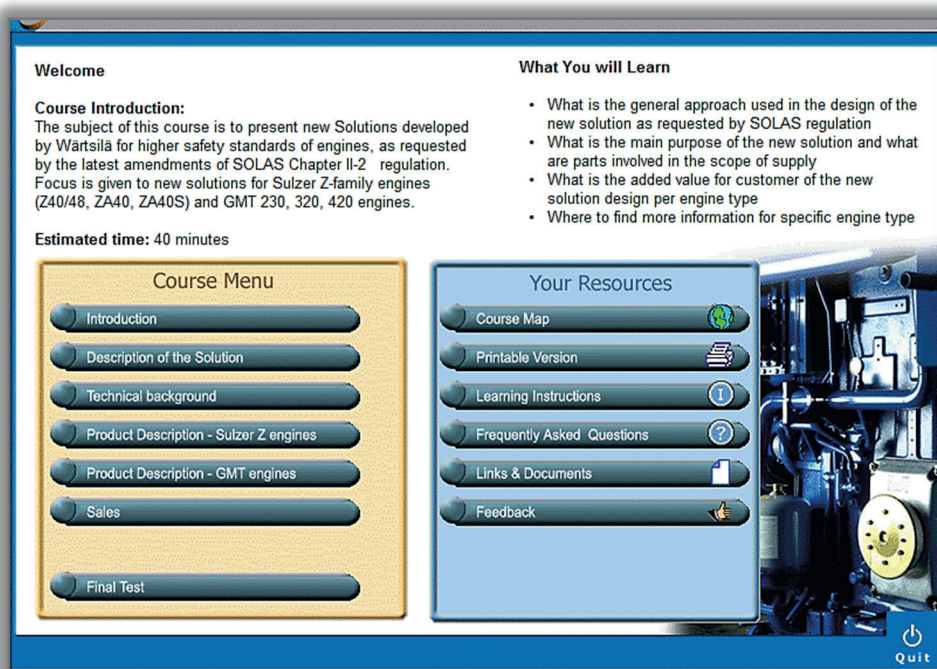
Image 2   Screen shot of the menu screen for iteration 2.

Navigation

In any kind of digital interface, there needs to be a logical way to navigate. Just as sailors navigated by the stars in ancient times, end-users of digital technology need markers to navigate by in the digital environment. The markers tell us where we are and where we can go, as well as instructing us on how to perform actions. These kinds of markers are often placed in a so-called navigation bar (Image 3 and 4), which is accessible throughout the course (cf. 2.3.1 on usability aspects discussed by Dix et al., 1997).

Image 3   Navigation bar at bottom of screen, iteration 1.
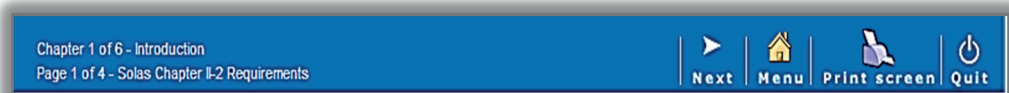
Image 4   Navigation bar at bottom of screen, iteration 2.

In the modules, the navigation bar (Image 3 and 4), including links for navigating the course material, was placed at the bottom of the screens in both course iterations (see examples in Image 13 and 14). In the first iteration, there was an image of a house with the text "Home" in the left corner, as can be seen in Image 3. Not many of the participants saw this image, and it created some confusion as to where it linked to. Therefore, the text was changed to "Menu" instead of "Home" in the second iteration. Also, the link was moved to the right side of the navigation bar where the other navigation links were. The first iteration of the navigation bar shows which page the learner is at within the module, for instance, "2 OF 4". There were also links for "Previous" and "Next" for moving forward or backwards, or "Quit" for quitting the course altogether.

Image 4 shows the second iteration of the navigation bar. Instead of only indicating the location of the page by "2 OF 4", the second iteration had a thorough description in the left corner of where in the course that specific screen was located, which can be seen in Image 4: "Chapter 1 of 6 – Introduction, Page 1 of 4 – Solas Chapter II-2 Requirements". Arrow symbols were added to the "Previous" and "Next"-links, and the "Menu"-link with the house symbol was moved to the right side with the other links. A "Print screen"-link was added, from where participants could print the specific screen they were reading at the moment, as well as another added symbol for the "Quit"-link.

Course features

There were approximately 20 different course features that I had listed for the participants to rate in the RESQUE questionnaire (see Appendix 2). These features were part of the instructional and navigational design. Examples are the introduction/instructions on the menu screen, links, images, photos, texts, headings, arrows, instructional buttons, multiple choice questions, etc. In the first iteration these course features were somewhat inconsistent in design, which appeared confusing to the participants. Here, I will explain the most serious problems regarding links, interactive features, and instructions, which were identified, and how these were changed for a better usability. I will briefly describe the most significant changes to the course features from screen shots from the two course iterations.

Image 5 shows the variations of font styles used for text-based links in the first iteration. This inconsistency of font styles used for links was removed for the second iteration, by using only one type of font for text-based links. Other changes made were consistent headings and titles, adding subtexts for images, and upgrading instructional buttons throughout the course.

Image 5   Inconsistency in font styles for links, iteration 1.

The two kinds of layout of links that worked best were numbers 1 and 2 in Image 5. The first alternative (blue and underlined) probably worked best, because it usually is the default link text layout that we have been used to in the Internet. The second link included an instruction (*See…!*), in addition to being blue and underlined. The last example (number 8) was not a link, but a title to a table. However, since it had the same look as the link layout that worked best, many participants thought it was a link. This became even more confusing, since what appeared to be a link in some cases was not in others. For the second course iteration, the links were written as an instruction in addition to being both blue and underlined.

In the first iteration, the instructions for interactive options related to images were somewhat inconsistent. In order to instruct participants that an image was a link of some sort, a few images (but not all linked images) had the instructive text: *Click images to learn more*. Other images had a symbol with two arrows and the text *Enlarge Image* (Image 6), whenever it was possible to obtain a larger version of that specific image. However, that particular button was placed in the far left bottom corner, which made it rather difficult to relate to the images, which were located higher up on the screen. We felt that this needed to be made more intuitive, logical, and consistent across all content.

Image 6   Instructive text and button for images as links, iteration 1.

In the second iteration of the course, a linked image was always made with a pop-up ALT-text instructing participants what to do, or what would happen if it was activated. This can be seen in Image 7, as the blue text box (ALT-text), which instructs participants to *Click to see details*. Furthermore, when participants mouse over linking images, a red frame appears around the image, indicating that the image is interactive. The idea was that there would be multiple ways of finding instructions, as well as multiple ways to access links and interactive features.
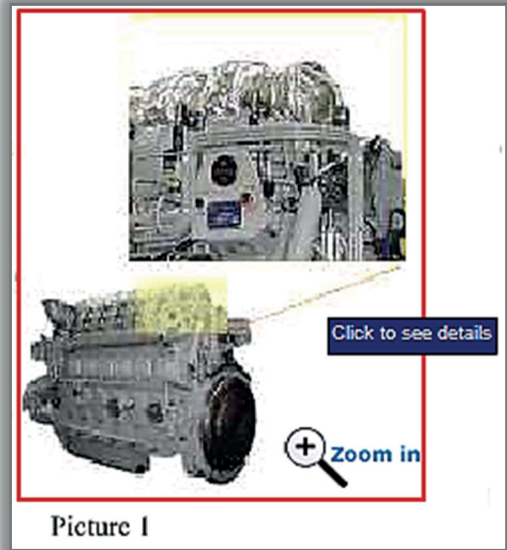
Image 7   An image with a zoom in function, and a red frame, iteration 2.

A magnifying glass with a plus symbol inside instructs the users to Zoom in, (as can be seen in image 7) and when they click on the link, the magnifying glass turns into one with a minus symbol, which instructs participants to "Zoom out" (as can be seen in Image 8). This replaced the earlier Enlarge Image-button used in the first course iteration (Image 6).

Image 8   Zoom out instruction link, iteration 2.

Practice questions

Following the last screen in every module, the participants were given the option of taking practice questions to repeat the information in the module. These questions all provided multiple choices including one or more correct answers. The questions were 19 in total for the whole course. The instructive text (Image 9 & 10 below) was the same in both course iterations, but the buttons in the second iteration were changed to practice questions instead of Practice, and to Course Menu instead of Continue.
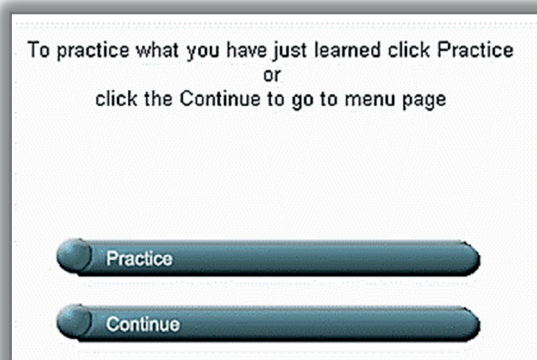
Image 9 Instructions for practice questions at the end of modules, iteration 1.
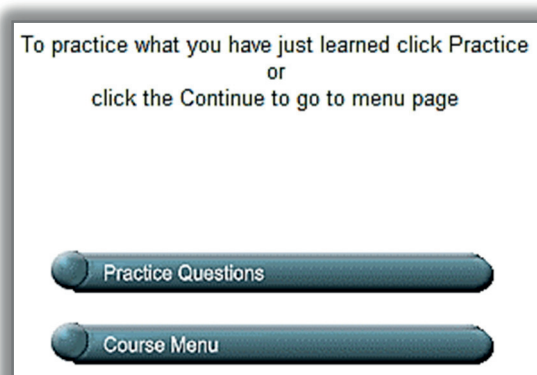
Image 10 Instructions for practice questions at the end of modules, iteration 2.

Check-boxes were used throughout all practice questions in the first iteration. This led most participants in Group 1 to assume that there was only one correct answer for each question. Because of this lack in the instructional design to highlight the difference, it was not clear to some participants that a few of the questions had multiple correct answers. For the second iteration, this was changed so that radio buttons were used whenever there was only one correct answer, and check-boxes were used whenever there were multiple correct answers to a question (Image 11), along with an instruction at the end of the question saying: *select all that apply!* Although the same instruction was used in the first iteration, it was clear that many participants missed the instruction altogether.
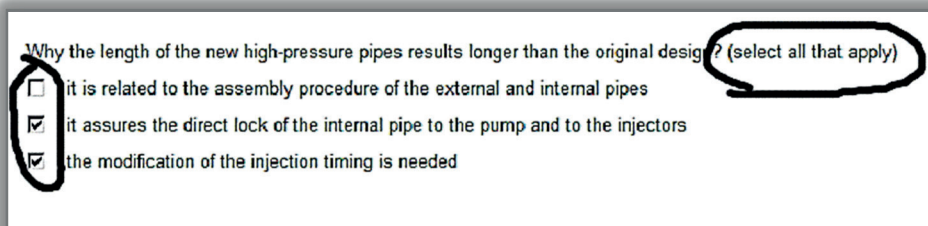
Image 11 Instruction for multiple correct answers using check-boxes.

Feedback on practice questions

On the next page, two screen shots illustrate the difference in how feedback was given to participants when they attempted the practice questions. In the second iteration, participants were given the correct answer as a pop-up box whenever they selected a wrong answer to the multiple choice questions, whereas in the first iteration there was only a pop-up box with the message of either: *Correct!* or *Not correct!*

In order to find out which answer was the correct one, the participants had to try over and over again until they received the pop-up message *Correct!* This was both time-consuming and frustrating for those who were stubborn enough not to give up. However, since there were no instructions on how to handle the *Not correct!* -feedback, it was too confusing for some to even try to bother with it. Images 12 and 13 are screen shots of examples of practice question from the two course iterations. One can see how the navigation bar at the bottom of the screen is different in iteration 2.
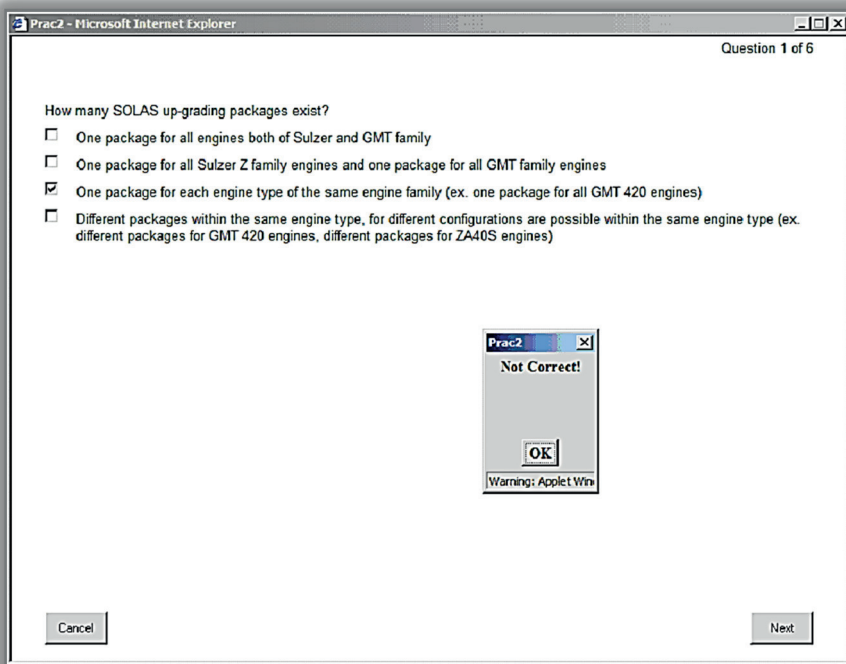
Image 12 Feedback for an incorrect answer to a practice question, iteration 1.
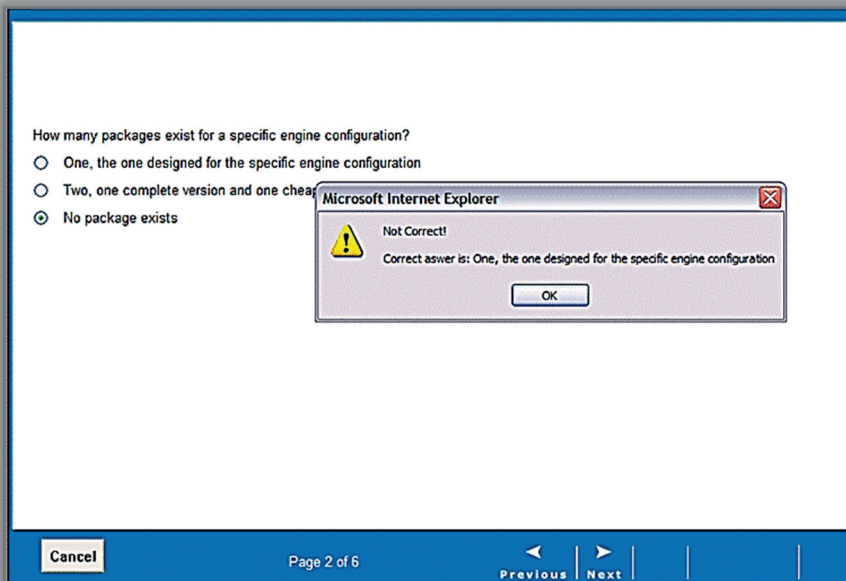
Image 13 Feedback for an incorrect answer to a practice question, iteration 2.

Final test

The Final test consisted of the same 19 questions as in the practice sections. To pass, participants had to receive a score above 75 % correct answers (15 out of 19). The most important feature missing in the first iteration was the score feedback from the Final test, which was unavailable in off-line mode. Hence, participants did not know how they had managed in the test, and had no idea which of the questions they had failed on. The only thing they were informed about was whether they had failed or passed.

The second group of participants received a pop-up window at the end of the test. This pop-up included all the answers, as well as the ones they had failed on. In that way they knew where they had failed and could go back and retake the test immediately. Their old answers remained intact within the 15 minute time limit set for the Final test, which gave them the opportunity to correct their mistakes. However, they had to read all the answers carefully in the pop-up window to notice which were correct/incorrect (see image 14). If they did not succeed in filling in the questions in 15 minutes, the pop-up window announced that they had failed the test.
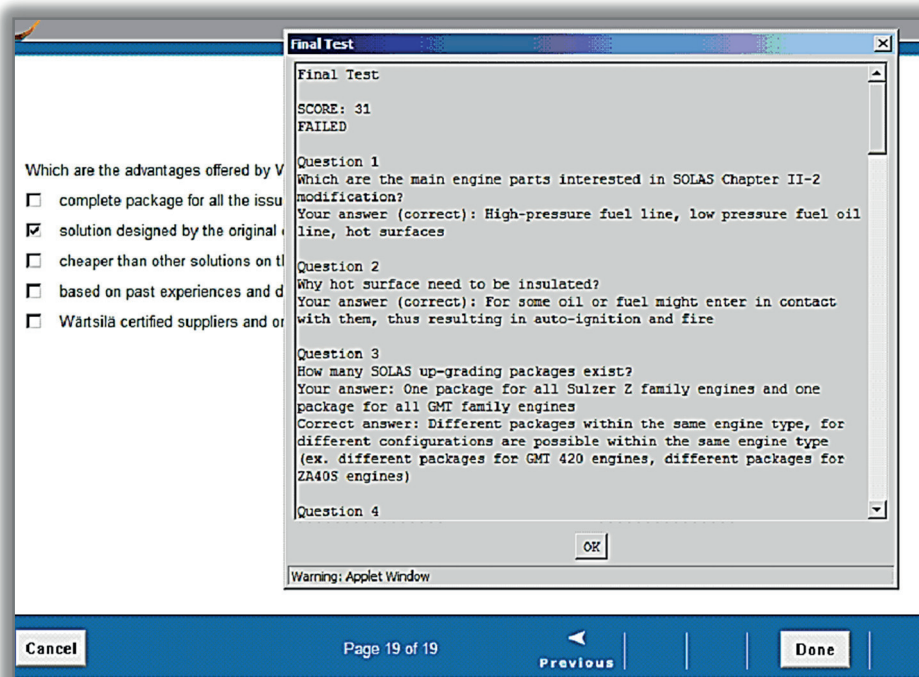
Image 14 Final test feedback on correct and incorrect answers, iteration 2.

7.4 Examples of learner actions and reflections

Narratives give insight into events. In this case, it is the storytelling about two participants' actual process of taking the e-learning course, i.e., their actions for learning and their interactions with the context in relation to their own reflections about this. The following tables (Tables 20-27) present two narratives of two participants' course work: one participant from each of the two course iterations. The two participants (P1, P2) whose stories I chose to use as examples are both successfully managing the learning environment. The narratives are based on screen observations in order to illustrate what can be detected from using this kind of observational method. No interpretations are made in the narratives. The purpose here is to give the reader an idea of the instructional design and content of the course, as well as examples of how these can result in different actions by the participants.

The screen recordings were used as the stimulus for their own reflections about their learning activities and choices. In the column to the right of the narratives are meaning condensations (cf. Kvale, 1997) of the stimulated recall interviews with the same participants. The method of meaning condensation was used as one of the steps in reducing and interpreting the interview data.

Table 20 Menu

The menu screen consists of two short texts: Introduction to the course content, and what you will learn. Below the text is a row of seven menu buttons linking to the modules and the test. The second iteration had another row of menu buttons for extra resources, including Course Map and Learning Instructions. The image presented here is from iteration 1.	

Iteration 1 – Participant P1		Iteration 2 – Participant P2	
Narrative of screen observation	Meaning condensation of interview	Narrative of screen observation	Meaning condensation of interview
When P1 reads the text on the screen, he uses the arrow head (mouse cursor) as a support, as he lets the cursor follow his eyes on the text. He reads the text on the page thoroughly with special focus on the paragraph "what you will learn". He quickly hovers the mouse over the menu buttons for the six modules and the final test. He decides to start with module 1 – the first in order – and clicks the menu button.	- He was afraid of getting lost in the navigation. - He needed more instruction on how to proceed, in order to feel secure in the environment. - He wanted to be able to see both the whole and the end before he begins. - He had expectations on the content. - He would have had a better overview with a paper version of the content. - He wanted to be able to plan his time, which he felt was made difficult based on the lack of course information and overview.	The menu screen is open, but he takes the print-out of the Learning Instructions and reads it through. On P2 he then chooses to look at the Course Map under the Your Resources menu. The course map is a list of all of the course modules and their content. He scrolls down and up again and goes back to the menu screen. The arrow head cursor hovers over the Your Resources menu, stops, and then he clicks on the Course Map button once more. He scrolls down the list more slowly this time. He tries to click on one of the headings at the top of the course map list, but is thrown back to the main menu. He then	- He wanted to see how everything worked and what he could do, before he started the course. - He looked at Introduction to see what it was all about. - He looked at Course Map to see what he was supposed to read to gain an understanding of the depth of the content; how detailed or general the content is. - The language made understanding more difficult. - He read twice: first, to form a conception of the whole, second, to understand. - He wanted to be able to see the end before

<table>
<tr><td></td><td>clicks on the first button of the Course Menu, which is the Introduction Module (previously Overview, but renamed for the second iteration of the course).</td><td>he begins, comparing this to a computer game where you have to visit all rooms before you run for the finishing line.
- He wanted to see the whole before going into details.</td></tr>
</table>
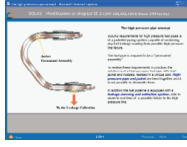
Table 21 Module 1

Module 1 (Overview) consists of three screens.

Iteration 1 – Participant P1		Iteration 2 – Participant P2	
Narrative of screen observation	Meaning condensation of interview	Narrative of screen observation	Meaning condensation of interview
After these screens you end up on a screen with two links: Continue or Practice Questions (PQ) as options. The first module has two multiple choice questions relating to the text. He reads the text on the page several times and tries all links a couple of times each. Then he chooses to take the PQ. He gets both correct.	- He was pleased with the information; considered it important to understand. - He liked how the interface had both images and text. - He classified the information as useless to memorise. - He thought the information on the screens was somewhat redundant and repetitive. - He thought the enlargement option was unnecessary.	After a few seconds on the first screen without any movement of the cursor, he clicks on the images to the left of the text. They all zoom in and additional text is shown. He begins to use the cursor as reading support and lets it follow his eyes on the text while he reads – but only for some parts of the text. On the second and third screen, the cursor is not used for reading, only to enlarge the image. He chooses to go to Practice Questions (PQ) and gets correct on both of the multiple choice questions.	- He took the linked images because they were there. - The images helped him. - He went back to read again when he noticed that the PQ required more detailed information than he had accounted for. - He began to feel acquainted with the type of multiple choice questions. - He noticed the instructions at the end of the questions ("select all that apply!")

Table 22 Module 2

Module 2 (Description of the Solution) consists of six screens.			

Iteration 1 – Participant P1		Iteration 2 – Participant P2	
Narrative of screen observation	Meaning condensation of interview	Narrative of screen observation	Meaning condensation of interview
He quickly scrolls through the screens until he comes to the last screen with the PQ link. He returns to the beginning of the module and starts reading from the first page. He tests all links and clicks on all images carefully to see whether there are any interactive features. He goes to the PQ option and gets 3 out of 6 questions correct. He goes back to the beginning of the module and reads the text again. He skips the PQ at the end of the module, but takes the same module for the third time, skipping the PQ again when he reaches the end of the module.	- He used critical thinking; valued the information and how it was used in real life. - He wanted shorter text rather than scroll down. - He thought the text was repetitive. - He thought the content was good. - He was thinking about how he understands it. - He preferred real life photographs. - He had prior knowledge of the content. - He was discussing how the information is to be used. - He liked the zoom-in feature when it highlights the place to focus of importance. - He thought that the text should have been divided into two screens.	He reads the text using the cursor as support. As he hovers over the text, red frames pop up around certain images. He stops for a while at these places. He checks all content (text, images, and links) for interactive features, enlarges every image and reads all the texts. When he takes the PQ he continues to use the cursor as reading support. He fails the first question and gets a pop-up with the correct answer. He reads this feedback using the cursor again. The next question he reads several times as the cursor moves back and forth along the text. This becomes his routine. He gets another incorrect and again reads the feedback carefully. He gets four correct and two incorrect on this PQ.	- He read the printed version to see if it provided additional information. But when it didn't, he put it away. - He tried to remember what he had read. - He considered this learning to be short-term, as it did not deal with his job. So he did not work too hard to learn on a deeper level. If it had been for his job, he would have taken notes. - He read headings first to get a picture of the content. - He read everything and thought it through. Then he read it again to understand. - He did not want to go deep into the information before he had seen the whole. - He does not mind scrollbars. - He looked at the page numbers and wanted to know how many pages were left. Without the page numbers, he would have scrolled through all screens before he started. - He would have liked to have two windows open simultaneously to compare details. - The images were a memory aid; something visual to link to the text.

| | | | - He read with the mouse cursor on the text.
- Zoom helped only a little. |
| | | | |

Table 23 Module 3

Module 3 (Technical Solution) consists of five screens.

Iteration 1 – Participant P1		Iteration 2 – Participant P2	
Narrative of screen observation	Meaning condensation of interview	Narrative of screen observation	Meaning condensation of interview
He reads the first three pages carefully, then glances quickly through the last two screens ending at the PQ screen. From there he scrolls backward to where he starts scrolling fast and reads it with normal speed this time, clicks on links and images on all options. Then he chooses to take the PQ option. He receives the Not correct feedback on one multiple choice question and takes the Back-link. When he gives the wrong answer, he begins to take the Back-link to choose another multiple choice option for the question, until he finds the right answers to the questions. When he cannot figure out the answer from the different response alternatives, he tests the various multiple choice combinations until he finds the right answer.	- He noticed the picture. - He reflected on the prior knowledge that is needed to be able to understand the content. - He has seen this information before. - He was critical of the choice of information in the course. - He reflected on why it is hard to understand the image, and was aware of what he would have needed to understand it better. - He wanted to see the parts in a sequence to be able to understand how they are related to each other. - He was critical towards how correct the information presented really was. - He related the information to real life situations and how it should be used. - Scanned quickly when he knew the information. - Considered the information to contradict his prior knowledge.	He begins to focus more on the text, as he repeats all the text or certain paragraphs as he reads. Less time is spent on images, although he goes through them all and enlarges them if possible. One diagram is, however, looked at more carefully as he runs the cursor along the curve of the diagram at a slow pace. For the PQ he continues to read the questions and multiple choice alternatives several times before making up his mind. He gets two PQ correct and two incorrect in this module.	- First, he scanned everything. - He thought the drawing was confusing because of all the lines. He preferred real pictures. - He wanted to read the text first, but the flashing arrows interrupted his attention, so he looked at the image first. - He tried to understand. The image showed that there is a difference between the pipes. - He looked for the difference. - He noticed that his pulse went up when he got the questions wrong. - He thought the feedback on PQ was good; great to get positive reinforcement and/or feedback on mistakes. -

Table 24 Module 4

Module 4 (Product Description 1) consists of three screens and four multiple choice practice questions at the end.

Iteration 1 – Participant P1		Iteration 2 – Participant P2	
Narrative of screen observation	Meaning condensation of interview	Narrative of screen observation	Meaning condensation of interview
He browses through the three screens quickly, then goes back to the first and starts reading the text. He opens all links available. There are two links to externally linked documents, which he also quickly browses through. When he arrives at the PQ option, he quickly scrolls back and browses through the module content before entering the PQ. When he is automatically returned to the menu screen, after the last question, he chooses the same module one more time and browses through it.	- He looked for the answer in the text. - He tried to think about the content as if he was the target audience. - He was frustrated by the lack of feedback. - He was critical towards how the information is interpreted by the course. - He was critical towards the content of the PQ. - He interpreted how the content is to be used in real life by viewing it holistically. - He checked all information to be able to classify it according to importance. - He classified the content. - He viewed the content from a practical point of view in relation to real life.	The three screens are read through in the same manner. He does not miss any interactive feature, such as scroll bars, links, etc. He opens an external link (technical documents), scrolls through it fast without reading, and goes back to the course content. As he enters the first PQ, he reads the question and immediately goes back to a table in the content where he knows the information can be found. He gets one correct and three incorrect replies here.	- The questions got him to read the text extra carefully; changing his way of reading. - He thought the questions made him reflect; helped him focus, although it wasn't a subject he was motivated to learn. If he had been interested in the subject, the questions would not have had that impact on his learning. - He both memorised and used logical thinking to understand. - He quickly scanned the parts that he considered to be not required to learn in the course. - He returned to the text when he noticed that details, which he had not memorised, were required. He thought that the level of the questions was raised at this point, which he was not prepared for.

Table 25 Module 5

Module 5 (Product Description 2) consists of three screens and two multiple choice question.

Iteration 1 – Participant P1		Iteration 2 – Participant P2	
Narrative of screen observation	Meaning condensation of interview	Narrative of screen observation	Meaning condensation of interview
He browses through the three screens quickly, all except the PQ. He reads the first screen carefully with most focus on the table. He goes to the second screen, only to jump back to the first screen to check something. He reads the text, clicks on all links, enlarges images whenever possible, and jumps between the third and second screen a couple of times as if comparing the information. He starts with the two multiple choice questions at the end of the module, but quickly returns to check some information in the text. He looks at the first and second screen, and then returns to the PQ. He gets the first question correct, but is taken back to the menu screen after the last question, although he gives an incorrect reply. He chooses to take the same module again, but is thrown out of the course – probably due to some bug in the system. He opens the course again and goes directly to module 5. He scrolls forward to screen three and looks at it a few seconds before going to the PQ where he skips the first question. He gets the second question right this time.	- He considered which other ways (outside the course) to get information about the content. - He was focusing on the customer's perspective. - He was focusing on important information. - He was unsure about the navigation and felt a lack of control.	Module 5 has the same table with product information as the previous module had on the first screen. He looks first at the table, and then at the text, which he repeats a second time. He then goes back to reading the text first as he did before. He repeats the text and takes all interactive options. While reading the first PQ he again goes back into the content to check the information in the table before answering the question. He gets one correct and one incorrect reply.	- Again, he expected not to have to memorise details for the questions. - He followed the links. He considered that he only had to learn the content generally – not to learn in depth. - He got stuck on a word he didn´t understand, got frustrated, wanted a dictionary to look it up. - He went back to the text to find the answer to the question he couldn´t answer.

Table 26 Module 6

Module 6 (Sales) consists of two screens and one multiple choice question.

Iteration 1 – Participant P1		Iteration 2 – Participant P2	
Narrative of screen observation	Meaning condensation of interview	Narrative of screen observation	Meaning condensation of interview
He reads the text and looks at the image on the first screen. He then goes to the second screen and goes through it somewhat faster than the first screen. When the PQ option comes, he goes back and reads through the two screens more carefully. Then he takes the PQ but fails it, although he chooses the right answer. He is thrown back to the menu, but he goes back to the module content, checks the information on the screens again and goes for the PQ a second time. He tries another multiple choice alternative, but fails again and is thrown back to the menu once more. He looks at the module content one more time and takes the PQ a third time, only to get another Not Corrrect!-reply. He is thrown back to the menu.	- He tried to understand and find the most important content. - He is critical about how the information is presented.	The two screens are read carefully, repeating the text twice and jumping between the screens a couple of times before entering the PQ. He gets the question correct.	- The images made him somewhat confused as to what they were supposed to convey.

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Table 27 Final test

Consists of the same 19 multiple choice questions from all the 6 modules			
Iteration 1 – Participant P1		**Iteration 2 – Participant P2**	
Narrative of screen observation	Meaning condensation of interview	Narrative of screen observation	Meaning condensation of interview
He clicks the final test -button in the menu and reads the information about the test on the next screen. He then goes back to the menu instead of beginning the test. He browses through the whole course content and goes back and forth a few times in places. He then prints out two tables which have caused trouble for him during the PQ. Finally, he begins the final test, reads the information about the test again, but chooses Cancel. The Failed Test screen appears. He clicks on Previous-button and gets the final test information screen again. He clicks on Next and gets the Failed Test screen again. He clicks on Next and gets the Passed Test screen. He clicks on Previous twice and is taken back to the final test information screen. He then chooses to start the test. During the test, he is looking at the printed tables several times. He gets 16 questions correct and passes the test.	- He double checked important information - He wanted to be able to plan his time and prepare for the test. - He thought he had the content under control. - He speculated how he would have done differently if he had had other kinds of prior knowledge; how he would have adapted to the expectations he had of the test situation.	Before he begins the final test, he reads through the Learning Instructions print-out one more time, in which the requirements for passing the final test are described. He then starts the test and goes through all the questions in order. He gets the feedback pop-up at the end on completing the final question. He reads through the feedback in which both correct and incorrect replies are listed. He passes the test and quits the course.	- He thought he learned something from the course. - He read the learning instructions. It confirmed the expected assessment format and the time limit. - He remembered which of the questions he had got wrong and his thought errors. - He felt no time pressure. - He had to think through it carefully because of the wrong alternatives. - He read the feedback after the test; first, the correct answers, second, the incorrect answers.

8 Results

How are digital learning designs influencing our self-regulated learning (SRL) as we "drive into the future" of learning (cf. McLuhan, 1964)? In this chapter, the results from the various steps of analysis are presented. The aim of the empirical study is to provide an increased understanding of how corporate e-learners manage an e-learning course with regard to their SRL. The results are presented in a logical order in relation to the research questions. These are separated based on the areas of SRL: overt SRL targets learners visible actions and behaviour; covert SRL targets the same actions and behaviour, but from the invisible perspective of cognition and motivation/affect in terms of how participants choose content; cognition is targeted both from the perspective of learning strategies and learning approaches; and, finally, user experience and affect is targeted by exploring how contextual aspects trigger and/or inhibit emotions. In the following table, all the research questions guiding the empirical study are presented.

Table 28 Research questions

Research questions
Behaviour: Overt e-learning management
1. *What are the observable differences in how participants, subjected to the two course iterations, take actions for learning and manage the course?*
Behaviour: Covert e-learning management
2. *Why and how do participants choose content and manage the context?*
Cognition: Learning strategies
3. *Which kinds of cognitive learning strategies are participants using in their course work?*
Cognition: Learning approaches
4. *How does the design of the course influence the participants' cognitive learning approach?*
Affect: Triggers and inhibitors of emotions
5. *What are the contextual triggers and inhibitors of positive and negative emotions experienced by participants of the e-learning course?*

The results presented in the following are based on phases of analysis covering varied perspectives of the participants' SRL grounded in the variety of data collected. These perspectives are to some extent overlapping, which can be seen in the categories presented. The overlap is inevitable, as the factors influencing how we learn, and the strategies we use, are intricately woven together as a dynamic process. An attempt to categorise and separate these factors will therefore result in an artificial representation of reality. The aim has been to explore participants' e-learning from a variety of perspectives, in order to capture their SRL as closely as possible. In the following presentation of the results, I adhere to the iterative analysis partly guided by the data, while a synthesis of the results is made in Chapter 9.

8.1 Behaviour: Overt e-learning management

The first research question targets participants' overt SRL behaviour pertaining to the participants' e-learning management (cf. the SRL area of behaviour by Pintrich, 2005). Overt SRL implies visible learning activities (Randi & Corno, 2005).

Research question 1: *What are the observable differences in how the participants, subjected to two course iterations, take action for learning and manage the course?*

I wanted to see whether and how visible differences could be found in how the participants managed the environment. Screen recordings were used, and the analysis targeted the participants' overt behaviour observable in these recordings. The data were approached inductively in order to see whether the participants' learning activities could be categorised independently of prior theoretical categorisations of learning activities. The purpose was also to use the analysis as a starting point for analysing the interview data. Based on the observations of participants' course work in Group 1, two preliminary categories of user activities were identified: navigating and manipulating. These categories were two different ways of interacting with and managing the e-learning environment. It was interpreted according to how the participants made choices for their learning activities. However, Group 2 taking course iteration 2 showed a clear strategy of manipulating the content based on the feedback that they received, which had not been available for Group 1. This was interpreted as a third category. The two previous categories were renamed in order to distinguish between the differences in where the direction of actions stemmed from. The direction of action refers to the source that triggered actions for learning, for instance self-direction is defined as a learner's independence in relation to outer sources of instruction (cf. Tobin, 2000).

Instruction-directed navigating

The verb *navigate* means to follow a path to a destination based on outside guidelines. Instruction-directed navigating actions were identified as those that used an instruction-directed exploring of the content and context. The participants followed the path of instruction through the course material. They were instruction-directed while navigating through the learning activities. The participants showing this type of context management followed the course in a linear way in accordance with a pre-set structure of navigating and completed the course from start to finish. For instance, they took the modules in a sequence from one to six, and continuously clicked on the Next-button for the next screen in order. They hardly ever deviated from this path, although it did not always benefit them, such as when someone failed practice questions, but still moved on without looking back.

Self-directed manipulating

To *manipulate* is to change the form of something, or influence something in accordance with one's own preference. Self-directed manipulating actions represented, in contrast to the prior category, the participants' self-directed exploring of the context, i.e., the participant created his own path and made his own decisions of where he needed to go in order to learn. An example of self-directed manipulating is seen in the first narrative of P1, presented in Chapter 6.

These participants seemed to learn how to adapt the environment to their needs for learning and be more flexible and adaptive towards the environment than the navigating participants. They developed their own strategies of manipulating in order to organise, repeat, and access the content. Three participants from Group 1 showed self-directed manipulating activities. The two who passed the final test in Group 1 were found among these three. The third participant would probably have passed as well, had I not been forced to stop him due to running out of recordable DVD-space. The two who managed to pass the course in Group 1, as well as the participant who managed to fill a whole DVD of recordings, were all interesting with respect to the manipulating strategies they used in comparison to the ones who failed in the same group. The passers of Group 1 manipulated the context in order to search for information, repeat, practice, print information, etc. They learned how to use the environment strategically in order to pass the course. The ones who failed in Group 1 were rather navigating through the environment in a linear way based on the instructions they got.

Feedback-directed exploring

In the second group five out of seven managed to pass the final test. Why the two participants failed the test could be explained with different factors[36]. The fact that feedback was important for reflecting on what the participants were learning became obvious when comparing Group 1 and 2. Group 2 was given feedback on their answers to the practice questions, as well as at the end of the final test. These participants therefore knew where they had erred, and could easily go back and correct it to earn a passing score. The feedback was a trigger for the learners to start exploring the environment in order to find and fill the blank spots in their knowledge base. Therefore, these kinds of explorative actions may be described as feedback-directed rather than self-directed. The term exploring is used to indicate that these participants deviated from navigating a linear path, and chose actions that guided them towards filling blanks of knowledge, instead of simply moving forward. However, in contrast to the term

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[36] One participant encountered technical problems and was thrown out of the course at the point when he got his score. He probably assumed that the course had ended, and that he had no more chance of correcting his errors. I did not notice this during the course session, so this was not discussed during the interview afterwards. The other participant who failed the final test in the second group had to leave because he had a flight to catch, and therefore did not have time to go back and check what had gone wrong the first time.

manipulating, the act of exploring is less focused towards using the environment in a manipulative way. This is possible, as the feedback triggered the explorer to search for specific content.

8.2 Behaviour: Covert e-learning management

The second research question is targeting participants' e-learning management by investigating their choices of content in their course work. This targeted the participants' covert (invisible) SRL in relation to activities (cf. Randi & Corno, 2005). Contextual monitoring, control, as well as attempts to regulate the context, are part of the SRL process (Azevedo et al., 2013; Pintrich, 2005). The stimulated recall interviews provided the data.

> Research question 2: *Why and how do participants choose content and manage the context?*

The purpose of this analysis is two-fold: to explore variations in both how and why the participants chose content: why the participants chose content involved their intentions behind their actions, i.e., the factors that influence their choices and actions for learning. How the participants chose content involved their concrete actions, i.e., how they managed the e-learning context in their learning activities. These two perspectives involve more than merely feedback as an affordance of the course, which was the main difference between the course iterations. Therefore, I have chosen not to distinguish between the two groups in the following parts of the analysis, but rather focus on variations of micro-level processes of SRL within the whole population.

The categories found in the observational data pertaining to context management were used as a starting point for coding the interview data. However, the inductive coding process of the interview data resulted in several subcategories of e-learning context management, as well as a new category of content management. One new category called Choice of Content Strategy was used for collecting all statements (N=111) pertaining to why and how the participants managed both the content and the context. These 111 references were further categorised into several subcategories. While reading through the statements carefully, interpretations were made regarding both the why-question and the how-question for each statement. Making a choice of content or action often entailed several influencing factors. I will describe these more closely in the following by separating the perspectives of why and how the participants chose content and actions.

8.2.1 Why participants chose content for e-learning management

There were often a number of combined factors influencing why participants chose to act in certain ways during their course work. Five main categories of factors influencing the participants' activities were: constraints, preconditions, affect, the initial course approach applied by the participants as a part of their e-learning management, as well

as content selection approach. These included 14 subcategories in total, which are presented in Table 29. All subcategories are illustrated through interview excerpts below.

Table 29 Factors influencing choice of content and actions

Primary categories		Subcategories
1	Constraints	Time
		Environment
		Physiology
2	Preconditions	Prior context experiences
		Prior content knowledge
		Norms of prior educational culture
3	Initial course approach	Preparatory
		Trial-and-error
4	Content selection approach	Novelty interest
		Pragmatic usefulness
5	Affective approach	Safety
		Convenience
		Interest
		Motivation

Constraints

A learning environment should support learning (Clark & Mayer, 2003). Features and tools that positively scaffold and facilitate learning are called environmental affordances (Peters, 2013). The opposite of affordances are constraints that somehow hinder or limit learning and actions taken in order to learn. A number of constraints were found to affect the participants' choices, such as time, environment and physical limitations. These constraints involved factors that somehow limited them in their choices of activities, and thus, how they chose content and actions in their course work.

Time constraints
Time constraints caused some participants to adapt their way of working and choice of content according to their conception of the time frame and time limits within the course. One participant explained how he made selections of content based on his uncertainty of the extent of the course, and the fact that he did not know how much time he would need to complete it. He skipped links to save time.

> The time… I didn't know how extensive it would be, how much course work I had to do. So I didn't follow these links. I only read the text that was there. [12-2]

Another participant kept checking the time during the final test, which was limited to 15 minutes. He wanted to be in control of the time in order to know how to plan his actions during the test, and to know whether he would manage within the time limit:

> […] maybe I looked at the timing also two or three times, hahaa! […] I was wondering … how much time do I take to answer three questions, then, ok, I saw the third

question, and then I took four questions. Then I found out, ok, are you supposed to check the timing and stuff, hahahaha … then after it was some … then I checked it … ok, here you can see, I checked it. […] Cause, it was in my mind that the answers take fifteen minutes or so, or twenty minutes. The final test, it said, might take twenty minutes, so I was just checking. Ok, it might take this much time. But if I had not taken the practice questions, then this would have definitely taken the twenty minutes that it said. [17-2]

Environmental constraints

The participants' ways of doing the course work were affected by the surrounding environment: its demands and disturbances. Factors discussed concerned both hardware and software issues, as well as environmental disturbances, such as noise, work load, etc. One participant described his concern with usability issues and software problems:

If you have a link to somewhere, and it's not working, then it's disturbing your … training session […]. Normally, on my own computer I would start to look at what the problem is. … But of course, if you have e-learning, and the computers are not working, then you start to be fed up, and you skip the whole training course if it's not working, and so on […] if you get the same problem always, then you think it's not worth it. It's not working, then somebody should fix it. Because then you have to concentrate on solving the problem with the computer, and you cannot concentrate on the training material. [03-1]

One participant felt that the laboratory environment enabled him to concentrate more than his own office environment would have allowed. This was evident in the following statement:

On a normal workday, I would not have been so effective and gone through everything… here there were no disturbances. [06-1]

During the course work in the lab, he had the possibility of concentrating without disturbances, and thus, could choose to go through all of the course content without having to make any selections. From his point of view, e-learning at work is perhaps not the best solution for good concentration and successful learning.

Physiological constraints

Reading on the screen and making own decisions for learning demands both motivation and concentration. One participant had only slept four hours prior to taking the e-learning course. This state of sleep deprivation affected his ways of working in the course.

When taking a course like this, you have to be rested […] in a normal lecture you will get the information although you're not looking at the lecturer. But here you have to read it yourself. For this you have to be [alert]. [12-2]

He felt that the e-learning environment demanded alertness of him on a different level than traditional training would. Other physical constraints influencing learning activities involved, for instance, the use of the mouse with the same hand as one would

normally use for taking notes. This was seen as limiting and hindered some participants in taking notes. Eyesight was another issue. One participant discussed the use of a zoom in function he accessed while reading the content:

> Then you can see what… when it's very small then it's not clear. If it would have been in red colour also... if it's in red then it becomes a total blur for me. [17-2]

He needed to see the image more clearly, so he used the zoom in function. He also commented that he has difficulty seeing when the colour red is used on the screen.

Preconditions

This involved how participants' prior computer experiences, prior content knowledge, as well as habits and cultural norms affected how they chose activities in their course work.

Prior context experience
Habits of acting were, for instance, transferred from other computer-based environments. The participants took actions based on prior experiences of how they were used to working with computers, opening documents, etc. One participant said:

> You're so used to opening all pdf-files and attachments in e-mails and in the information-channel. You open it automatically to look what it is. [14-2]

For this participant it was a habit to check everything out on the screen. He noted that this habit came from his ways of working with e-mails and other computer-based information.

Prior content knowledge
The choices of content and actions were often influenced by the participants' prior content knowledge. This were either done so that participants chose to look more closely at things they did not know in order to fill gaps, or chose to look at information that they could build on from what they already knew. One participant did not follow a number of links and explained it like this:

> […] because I already know what they are - all of those things. [01-1]

He skipped the links because he felt them as being unnecessary for him due to his prior content knowledge. Another participant discussed a topic he knew something about, related to the content, and then justified his choice of links by saying:

> It was fun to see what this looks like on a Z. [10-1]

He chose the information that gave him added information regarding what he already knew, simply because it interested him.

Norms of prior educational culture

Our values regarding right and wrong related to learning, as well as our epistemic beliefs may be derived from the prior educational culture we are familiar with. While discussing printing options and use of such materials during the final test, one participant commented that he felt that such a strategy would be cheating and morally wrong according to the norms of his prior educational cultural and his standards of what learning should be or not be.

> Maybe graphs like these charts. I could have [printed] but …
> *[Interviewer: You could have used them in the final test, for instance.]*
> No, not, maybe.
> *[Interviewer: Would you think that was cheating?]*
> Yeah. If you have the answer then you just read and write the answer.
> *[Interviewer: It's still a possibility.]*
> Yeah, it's a possibility, but I …I don't know.
> *[Interviewer: Would you have felt that that was morally wrong?]*
> It would feel like cheating, exactly. We're not used to open book examinations in [place]. That's not a concept in [place]. [17-2]

He would not even have considered it a possibility to print, for instance, tables and diagrams including the information needed in the final test, which was done by a few other participants taking part in the course.

Initial course approach

Here, course approach for e-learning management implies the initial approach the participants had in starting out in their course work; why they initially managed the course in a certain way. This can be compared to the SRL phase referred to as preparatory phase (Puustinen & Pulkkinen, 2001). This phase includes forethought (Pintrich, 2005; Zimmerman, 2005), planning (Greene & Azevedo, 2009; Pintrich, 2005; Winne & Hadwin, 1998), goal setting (Greene & Azevedo, 2009; Winne & Hadwin, 1998), and activation of, for instance, perceptions of the content and the context (Greene & Azevedo, 2009; Pintrich, 2005). A distinction between a preparatory approach and a trial-and-error approach could be made for how participants approached the e-learning course. It became evident that there were two layers of the e-learning course that needed to be managed: the e-learning context (the digital interface) and the course content (the information to be learned). Some participants mentioned the importance of preparing themselves before starting the actual course work. Others had an opposite attitude about how to start off in the course, using a trial-and-error approach. They seemed to be transferring their approach from prior experiences of HCI encounters (cf. categories of preconditions and prior context experience), such as gaming, reading e-mails, opening attachments, or learning new computer programmes.

Preparatory

The participants taking preparatory actions towards the content used strategies to cognitively prepare themselves for learning the content. The following statement is expressed by a participant who is well-articulated in his way of describing his preparatory approach for handling the content:

> It's good to have some guidance in your mind, what you think in advance what would be the content of the whole course, then you know it in your mind when you go through the whole text, and … so you know what your attitude should be about this, what they would like you to learn, and if you need to raise some questions in your mind to yourself, to make it easier to understand. [04-1]

He had a conversation with himself about the content in order to raise awareness and expectations. Participants having a preparatory approach towards the e-learning context used strategies to form a preconception of what they were about to encounter. This was, for instance, to make sure they would get the most out of it. This excerpt illustrates a preparatory approach for handling the structure of the environment:

> I thought I would go through everything on the [menu] page, what you could do, and how everything worked, and where it linked […] before I started the actual course. [16-2]

He wanted to prepare himself for all possible ways of managing the e-learning context before engaging with the content. He compared this way of working with playing computer games:

> It is the same strategy that you have when you play computer games. You can't just run for the goal, you have to enter all rooms first [16-2].

Trial-and-error

This was an opposite approach to being preparatory in how participants approached both content and context. Participants having a trial-and-error approach did not have any thoughts or opinions about the content beforehand. The following statement exemplifies how one participant had a trial-and-error attitude in approaching the content:

> I didn't know what to expect, so I just started. I just read and started. [05-1]

Hence, he jumped into the content without any mental preparation for what to expect. Similarly, there was a trial-and-error approach towards the e-learning context. Participants entered into the course context without preparation, trusting their abilities and that the structure would take them where they needed to go in order to succeed. One participant discussed his habits of learning to use computers through a trial-and-error approach and how this influenced his way of approaching this course:

Handling something like these things [the e-learning context] is not that tough. It's quite easy. Maybe it's because I've learned all the computers I've had just by using them. [17-2]

Content selection approach

The intentions of participants for choosing content were often directed towards the value they prescribed to the content. This revealed their goal-direction towards learning the content. For instance, how they aimed at simply filling gaps of knowledge based on their interest, or rather choosing content that was relevant for their own work.

Novelty interest

Some participants aimed for new information that would fill their gaps of knowledge. I call this a novelty interest approach. In order to be able to patch one's gaps of knowledge, one first needs to identify what one knows. This includes a certain skill of information identification, categorisation and organisation. While asked why he took the second link before the first one, one participant explained that he chose new content based on interest guided towards novelty:

> Because I was not familiar with [this]. But these are the same that we are dealing with every day, so … […] That's why I was more interested in this one. [04-1]

Here we can see how several factors influenced his choice: he wanted to fill his gaps of knowledge, and he stated that he was more interested in information he did not know (interest and prior knowledge). Another participant read one part of the text more thoroughly, and explained in a similar way:

> This system was new to me. [05-1]

Another example of filling gaps of knowledge using a novelty interest approach is shown in how this following participant skipped the link to the pictures he was familiar with and only accessed the ones that were new to him:

> I had never seen one like this […] so I checked that one out […] I know what the other one looks like. [15-2]

Pragmatic usefulness

These participants chose content based on what they needed for their work. The next excerpt shows how one participant skipped things he felt that he already knew, or things that felt irrelevant to learn or memorise. He simply chose to do the minimum of what he felt was needed in order to pass the course. While asked why he skipped the practice questions, one participant explained:

> I thought it would be a waste of time for me. [07-1]

Another person with a pragmatic approach said:

> […] this is very good information when I'm looking for something detailed. But it's not information that should be […] memorised. [08-1]

He pragmatically decided what kind of information that would be useful to know. Another participant said:

> This was something I decided not to read […] I thought it was not required. [13-2]

Being pragmatic is to evaluate the information and make choices based on one's own needs and opinion about the usefulness of the information, rather than to let the course designer's choice of information guide one's path of learning. Being pragmatic involves being self-directed in one's choice of content. For example, prior knowledge, interest and time constraints are factors that all may influence a pragmatic approach towards choice of content.

Affective approach

The affective approach involved how the participants' activities were influenced by intentions on an affective or emotional level (cf. Pintrich, 2005). This had to do with how they tried to avoid negative emotions and increase positive emotions. For instance, whether they preferred to make choices that felt safe, or choices based on interest. This also included how the participants took actions to raise motivation, and whether they took the easy road based on convenience.

Safety
Some participants took actions aiming at avoiding anxiety-evoking scenarios in order to feel safe, and stay with what they already knew. They wanted to stay within structures they had experienced before. Having skipped the practice questions, one participant explained:

> I was thinking that it might be a terribly long questionnaire […] and how I would then be able to come out of it and back to the course. [10-1]

He chose not to take certain content because he was afraid to get lost in the e-learning environment, and to face something that required lots of effort. Choosing not to take this particular content felt like a safer choice to him. The same participant looked at one of the practice questions, but never tried to tick any of the multiple choice boxes. He explained his actions like this:

> I … it was difficult to understand what they really meant with it. It was like … it was difficult to understand […] it was the question […] it was difficult somehow […] and to know where you should tick, like that […] I think I know now. It was this question in the test that was … didn't understand anything. [10-1]

He chose to not even try the multiple choice alternatives, because he felt he did not understand enough of it. In that sense, the safety approach is linked to a low self-efficacy belief both regarding context management and understanding the content (cf. Bandura, 1986; Pintrich, 2005).

Convenience

Making a choice based on convenience is taking the easy road. When asked what he would do when confronted with a content-based difficulty within the course, one participant answered:

> Then you would have to take Back and Continue [navigation buttons], and then you wouldn't find your way back, and take all the questions again, or…, that's too much work. […] If it's possible, you will climb the fence where it's the lowest. Humans are lazy by nature. [01-1]

His solution would be to skip the problem and move on because it would be the most convenient thing for him to do. For one, he did not trust the usability of the navigation to give him a transparent view of where he was in the course. Second, he did not want to put in the extra effort. This shows how ability for effort regulation might be hindered by usability or perceived usability flaws such as lack of transparent overview of content. This participant belonged to Group 1, for which there was no Resources menu including the Course Map. Another participant expressed how he would have used a more convenient approach had he known that the final test questions would be the same as the practice questions in the modules. He said:

> If I had only known that [...] I would have read the questions more. [02-1]

By this, he admitted that his choice of actions are influenced by the course assessment (cf. Biggs et al., 2001; Richardson, 2000). Some features, such as scroll down text, were discussed by one participant, as he had not scrolled down to read the whole text. He said:

> Yes there is a risk that it is boring, and that you don't bother to read to the end. [15-2]

This participant was intimidated by the scroll down feature and chose a convenient approach by skipping it altogether. This shows how the interface design impacts choice of actions, which then have consequences for learning.

Interest

Choosing content based on interest is an action stemming from intrinsic motivation (Deci & Ryan, 2000). Here, participants chose actions based on interest in the content or curiosity about the environment. Curiosity is being drawn toward something based on a positive association, while the opposite goes for actions based on safety, where one avoids something based on a negative association. The following statement describes how a participant focused more attention towards content that he felt was the most interesting:

I looked more closely at this one. It was rather special. [05-1]

The opposite was expressed in the following excerpt. The participant explained why he only moused over a link, but did not access it:

Was it so that I read this […], and I thought that, ok, it's just those engines, and that's not the information that I am interested in. [08-1]

Motivation

Some participants showed an awareness of the importance of keeping up motivation (cf. metamotivation in Boekaerts, 1995; Pintrich, 2005). Based on this awareness, they took certain actions to regulate motivation to manage the learning situation. This represents an ability to sustain effort in order to reach a goal (Boekaerts & Cascallar, 2006), or in other terms, volitional control (Deimann & Keller, 2006; Kuhl, 1985). One participant felt annoyed about having to view a difficult table a second time. He needed to raise his motivation and searched for something to tell him how much he had completed thus far.

I noticed that I was pretty close to the end, so that helped […] had the screen kept up my interest, maybe I wouldn't have gone there […] I was maybe looking for something to motivate me. [14-2]

This is an example of an action taken in order to increase positive emotions, and thus, regulating motivation (cf. Ben-Eliyahu & Linnenbrink-Garcia, 2013, on reappraisal as an emotional self-regulatory strategy for how emotional shifts are regulated while learning). This participant [14-2] possessed meta-affective skills (Burleson, 2013), which facilitated his learning process and adaptation to the learning environment. A similar approach of regulating motivation is to avoid actions in order to decrease negative emotions as a means to keep up motivation. The next excerpt illustrates this kind of action.

I opened … it was probably here I opened it. I have read these […] before, and I find them very, very boring. So when I saw [it], I thought, oh this kind of text again, and I closed it. [08-1]

These two examples represent actions for regulating affect and motivation, either by moving towards positive triggers, or moving away from negative triggers.

8.2.2 How participants chose content for e-learning management

How the participants chose to act implies the strategies they used, and in this case, it refers to how they chose content, in contrast to the previously discussed why-question targeting the participants' intentions behind their actions. In the previous section, for instance, e-learning management was discussed in terms of why participants approach the context either using a preparatory approach or a trial-and-error approach. Here, I

explore the how-question in terms of concrete actions related to content and context (cf. Pintrich, 2005).

While listening to and analysing how the participants took certain actions in their course work, a number of strategies were found for how they managed the e-learning course in concrete ways. This also included how they acted when they faced difficulties. Table 30 shows six micro-level SRL strategies, divided into three primary categories, of how the participants chose content and actions in their course work. The first primary category includes content selection. It represents how participants selected content. The second primary category includes context navigation. It represents how participants navigated and manipulated the e-learning context (cf. interpretations of the observational data). The third category describes their problem management strategies. The six subcategories will be further defined and illustrated by interview excerpts in the text below.

Table 30 Strategies for choosing content and actions

Primary Categories		Subcategories
1	Content Selection	Selective
		Wall-to-Wall
2	Context Navigation	Linearity
		Exploratory
3	Problem Management	Pursuance
		Avoidance

Content selection

These are variations of how the participants used strategies to choose content in their course work. These actions, categorised as content selection strategies, had their source in the participants' focus on content as a trigger for doing something. A distinction could be made between those who were selective regarding choice of content, and those who covered the content completely from start to finish.

Selective
Being selective involves a certain degree of self-directedness and ability to define one's own information needs either for work or for passing the course based on extrinsic evaluations. These participants were pragmatically selective in their choice of actions, only choosing certain content and features based on their own evaluation of, for instance, how necessary and interesting they were. Therefore, the selective strategy may be based on the approach of pragmatically evaluating the usefulness of the content, and hence it is strongly related to both short-term and long-term goals. One participant described it like this:

> I guess I didn't enlarge it, because it's just a bigger one if you click it. And you can clearly see what you want on this one. [04-1]

He further did not click on something just because there was an opportunity to do so. Instead, he selected information strategically. He further accessed information based on what he thought was necessary for the course. He said:

> Now I quickly went through [an externally linked pdf], because I thought that it's not that detailed that I need to be familiar with it after this course. [04-1]

Another participant had the same selective strategy, as he skipped content by categorising it as not relevant to his work.

> … when it was specifically about [engine name], then I have jumped some here, because I thought that it wasn't for me. [05-1]

He explained that he was not trying to achieve a 100% correct score, but to select the information that was most important for his work:

> What is the purpose of the course? Is the purpose to get a 100% score? That is a totally different thing than trying to find what is most important to you. I tried the second option. Not to get a 100% score. That's why I have skipped, or not read carefully enough. [05-1]

He is selective towards content because of his goal-directedness for pragmatic work related reasons, which is a typical attribute of an adult learner (Brookfield, 1996; Knowles et al, 1998). The next excerpt illustrates the same selective strategy as one participant skipped all the practice questions:

> I thought it would be a waste of time for me. [07-1]

Wall-to-wall

These participants covered everything in the course – they moved from wall to wall – either because they felt it was required, or because they had the habit of exploring everything just to see what it was. The next statement illustrates how one participant kept accessing all links, texts, and images, because that was his routine of working with computer-based material:

> I just keep on looking at things. [17-2]

Another participant said:

> There is probably someone sitting somewhere checking that I have completed the whole course, and if I leave something out I get an incomplete score. So, I might as well take it all and get it over with while I'm at it. [15-2]

He felt it was a wiser choice to cover everything in order to make sure he passed the course according to the demands set by the course designer. His wall-to-wall strategy was thus extrinsically motivated (cf. Ryan & Deci, 2000), while the above mentioned excerpt illustrated a participant guided by his habit of working with the computer. In

the next excerpt we can see how a wall-to-wall strategy is aimed at creating a deep understanding of the material, as well as a way to organise the content in the participant's mind so that he knows where he needs to put his focus and attention towards the most important content:

> Yes, I read it [the headings], then I read the text, and then I read the text one more time, and then I read and think through what they have said. […] I first want to read everything so that I know what it is all about. I want to get everything. And then I can read again and understand. Otherwise, I might start concentrating too much, for instance on the first paragraph, and get too deep into that one instead of reading the rest. It gets too deep into something. That's why I have to first ... once ... so that I know what it is all about. [16-2]

He read the whole text first to form an overall understanding of the content, and to be able to find the most important information to concentrate on, then he read the text several times and thought it through until he understood. This participant did not have much prior content knowledge compared to the other participants. He might, therefore, have used this strategy. However, he combined it with using a preparatory approach both towards the content and context, though it is understandable that one may become more selective the more experienced one becomes.

Context navigation

This refers to how participants managed the e-learning context on a more technical level; how they navigated, manipulated, and explored it. The two categories identified and described below can be compared to the categories found from interpretations of the observational data: navigating, and manipulating. However, I have chosen to rename them, as they both represent navigation strategies: only one is a linear navigational strategy, while the other is an exploratory strategy.

Linearity

These participants followed the structure of the system in a linear way. They were searching for the logic of the structure, in order to figure out how the course designer had planned how one should go through the material. One participant said:

> The way I used it, was actually almost like reading an electronic book. [13-2]

He took all the screens one after the other in a linear sequence. He also commented:

> I wasn't sure [how it worked], but at this point I started to get a hold of the system and I'm continuously clicking this Next-button. [13-2]

He was trying to find and follow the logic of a pre-set navigation structure (cf. instruction-directed navigating category from observational data). Another participant explained his concern about navigating the e-learning context, and also comparing it to

a book. However, this participant actually felt that a book would be easier to use in a more flexible way compared to the e-learning course. He [15-2] said:

> It is much easier to jump back and forth if you have a book.
> *[Interviewer: Would you like to jump back and forth more?]*
> Yes, absolutely. I would have taken … gone back and forth more freely.
> *[Interviewer: What stopped you from doing that here?]*
> It would have taken so long to look for where it was […] where the information was that I would have needed to see within a second. I was not prepared to invest 5 seconds, only needed to glance quickly where the thing was […] I knew that I would not find it here in 30 seconds, so I let it be.
> *[Interviewer: Was it an overview that you were missing?]*
> The overview. Exactly. [15-2]

Thus, this participant was inhibited by the e-learning context to explore freely, as he was convinced that he would lose his way and not find what he was looking for quickly enough. While reading books, he was used to using a strategy of jumping back and forth, in order to check up, clarify and relate information. Here, he stuck to a linear strategy to stay in control.

Exploratory

These participants explored and manipulated the environment in flexible ways. They did not feel that they were bound by any pre-set linearity in the structure. Their choices of how they were moving around in the e-learning environment were pragmatic. They made their own road based on their own interest and/or needs. One participant skipped all practice questions during the first half of the course. Halfway into the course, he started to take only practice questions, skipping the text. He jumped back and forth between questions and text in order to find answers to questions he got incorrect. He replied:

> I thought I would test this [practice questions] a little bit in between. […] I was aware that I began to take only the questions at this point, but it was not a strategy. [06-1]

He manipulated the environment in a flexible way in order to pass the final test. Exploratory strategy can be a powerful way of pragmatically aiming at filling one's gaps of knowledge by using the resources available as flexibly as possible. (cf. self-directed manipulating category from observational data). Another participant was trying to sort out something in the content that he found odd. His way of doing this was to go back and forth in the text, in order to find the correct answer to one of the practice questions. In his opinion, and according to his background knowledge of the content, he thought that the content might be incorrect.

> This here was difficult. Or I would like to argue that the question was incorrect […] it didn't match up with the material, I thought, although I really tried to see. [02-1]

Problem management

When it came to problems the participants faced during their course work, there were two evident strategies present: they either struggled to solve the problems by addressing them, or avoided the problems and moved on. These two dichotomous strategies were found related to both technical problems of the e-learning context, as well as to the content.

Pursuance

Pursuance is the quality of addressing problems if needed. These participants saw technical problems as something unavoidable in a computer-based environment, and when problems occurred they solved them in the best way they could with the available resources. For example, there was a bug in the first course version. Instead of giving the learners the option of choosing the Back-button in case they answered the last question of each chapter incorrectly, they were thrown back to the menu screen. One participant solved this problem by quickly clicking through the whole chapter again in order to get to the last practice question. He did this over and over until he got the question correct.

> The last question was difficult, because you could not come back for that one […] then I needed to go through all the section to come back there. […] But I did not read the text then, just … [09-1]

When some participants were faced with a question, or something they did not understand completely, they searched for the answer by using the resources available in a flexible way. For instance, one participant jumped back and forth several times between practice questions and the text. He even printed a table with lots of data in order to be able to answer the practice questions; hence, he investigated the content until he found what he needed.

> There were some questions that I couldn't find answers to, although I went back to the text […] I just ended up doing that. I had not planned on going back. [02-1]

Avoidance

This strategy is the opposite of addressing problems. Some participants avoided technical difficulties or ambiguities as far as possible. If something seemed to be problematic to access or manage, they simply skipped it. For instance, one participant constantly avoided all links that had a two-step structure of hyperlinks to open an external document. He took the first hyperlink, but chose "cancel" when the second link came up. He was dodging potential technical problems to stay on what was the safe side according to his judgment. His explanation was:

> I didn't dare to try again…in case something terrible should happen (being ironic). [10-1]

Another participant did not bother to find answers to questions raised in his head by the course content, since there was an option of avoiding it. He simply ignored these kinds of questions. When asked what he does when facing difficult content, he replied:

> Everything goes so fast in a course like this. Instead of facing problems, you just click and move forward. When there is an option to do so. [01-1]

8.3　Cognition: Learning strategies

The third question targets how participants discussed their learning and how this was or was not supported by the e-learning environment, i.e. their reflections on their cognition in relation to the context of e-learning. This question was explored through the interview data.

Research question 3:　*Which kinds of cognitive learning strategies are participants using in their course work?*

The previous analysis focused on variations of how the participants chose content and took actions in their course work. Their cognition was only touched upon from a secondary perspective. However, the third phase of the analysis targeted variations in their cognitive learning strategies. A learning strategy is a goal-directed action taken in order to learn something (e.g., Weinstein et al., 2005). A cognitive strategy is also a learning strategy, but the covert or invisible process of a learning activity; how one thinks and regulates one's thinking in various ways in order to learn something (Pintrich, 2000; 2005). During the inductive coding process of the interview data, one subcategory was named "Relating to Learning". The main purpose was to collect all statements (N=132) where participants reflected on their learning in order to unveil cognitive learning strategies and how these were facilitated or not by the course context.

This analysis further explored the relation between the instructional design of the e-learning course and variations in how the participants discussed cognitive strategies and needs during the stimulated recall interviews. It was assumed that how participants discussed their cognitive learning strategies would also illuminate both internal and external factors that facilitated their learning process. When asking them directly what kinds of strategies they were using during their course work, they usually referred to having no specific strategy. How we learn is often an intuitive and subconscious process (Richardson, 2000). However, while listening to how the participants discussed their own learning within their course work, several variations of cognitive strategies were found. These could be separated into four primary categories: 1) how they organised and managed the content, 2) how they understood and integrated the information into their prior knowledge base, 3) how they monitored this comprehension process, and 4) how they regulated their cognition. These four include a total of 14 subcategories of micro-level SRL strategies, which are presented in the table below, as well as described and illustrated by excerpts from the interviews.

Table 31 Categories of cognitive learning strategies

Primary categories		Subcategories
1	Information organisation	Categorisation
		Sequencing
2	Comprehension & Integration of knowledge	Critical thinking
		Elaboration
		Knowledge patching
		Comprehension through variation
3	Comprehension monitoring	Cognitive preparation
		Information clarification
		Practice & repetition
		Note taking
		Self-testing
		Meaning negotiation & social feedback
4	Cognitive regulatory control	Modality preference regulation
		Attention regulation
		Effort regulation

Information organisation

Organisation helps learners in selecting the information to be learned and in building internal connections within (Pintrich et al., 1991; Weinstein et al., 1987). It concerns organising and transforming information through self-initiated overt or covert rearrangement of instructional materials to improve learning (Zimmerman, 1989). The content of the course is the information to be learned. Managing this information involved the ability to organise it by categorising it regarding its value; for instance, identifying what kind of information is the most important and which is less important for the goal one has. The participants further chose to access the information in a variety of ways, i.e., sequencing information for various reasons.

Information categorisation
As one participant accessed an external link to a PDF-file including lots of technical information, he explained:

> You open these and scan through them to see what's in them […] there can't be anything really important [information] in a link like this. [02-1]

He made an evaluation of how important the content was in relation to the rest of the course content. He categorised it as less important in this case, as it was an external link only. The next two participants were aiming for what they thought was most important. Two examples of this are represented by the following statements:

> I read this [the heading] first, because it's a bigger font. Makes me think that it's more important. [04-1]

And another participant [11-2] said:

> Over there, I was reading text only […] because there is a lot of text and a very small picture. If there are more details on the picture, then I look...
> [Interviewer: So you think if there's a lot of text, then…]
> …they want me to read, so I read. [11-2]

The first participant noted that headings are important, and therefore he read them first. The second was searching for density of information in order to find key content. He was also expressing an extrinsic goal-directedness as he explained that he read what he thought the course developer wanted him to read. Hence, his goal-directedness was the trigger for his choice of categorising content.

Information sequencing

The sequencing of information is a strategy used for increasing understanding, as well as easing this process by accessing the information in a way that aids the learning process. One participant explained:

> When the screen pops out like this, I think I start with the picture, and then I read the text. Because when I see the picture, then I know immediately what will come in the text. [08-1]

He looks at the picture first, because he sees it as a preview of the text content. He is sequencing information according to his preference for learning, and to obtain a quick overview as a preparatory approach. The opposite way of sequencing multimodal presentations is described in the following excerpt:

> Maybe at the start, I normally read and then look at the picture. But once you get some idea, maybe you go for graphics more than text. Ok, if it had been a drawing or something, then maybe I would have gone for that first. Just to get an idea of what it is, and then keep on switching … [17-2]

He is sequencing the information, and switching between the modality representations according to what gives him the best idea of the content. However, he usually starts with the text. During discussions about frequently asked questions (FAQ), two participants explained that they preferred to look at FAQ after the content itself; however, for slightly different reasons. One participant discussed how he preferred to look at FAQ afterwards because sequencing information as such enabled him to understand the questions better when he knew what the content was all about.

> Because first I see what it consists of, and then see the questions. Otherwise … the other way round would be difficult, yes. Why they are asking these. [11-2]

He looks at FAQ after the course work is complete as he finds it easier to understand others' questions when he has formed his own understanding of the content (comprehension). The other participant wanted to be autonomous in creating his own

conceptions of the content, not being affected by how others think about the content. He [12-2] explains:

> … but I never look at FAQ. I'm not the kind of person that asks the same questions as everyone else [...] I want to create my own conceptions
> *[Interviewer: so you do that first, and then you can see what others have …]*
> Yes, exactly, what others have reflected on. So therefore, FAQ is something I don't like. Because then you are like everyone else, and I'm against that.
> *[Interviewer: Does it limit your thinking?]*
> Yes. [12-2]

He chose to read FAQ at the end only, similar to the participant above, but for a different reason, which was linked to his need for autonomy (cf. Deci & Ryan, 2000).

Comprehension strategies

These strategies target how participants used cognitive strategies in order to understand the content: they were patching content from various sources, and elaborating on and/or being critical of the information based on the level of prior knowledge they had. Another aspect discussed was focusing on variation in information in order to understand.

Knowledge patching

A patching strategy involved actions taken by the participants in order to build on their own knowledge from different sources or forms of presentation. The aim was either to look for more information, or to confirm pieces of information for the purpose of adding to their own prior patchwork of knowledge (cf. Illeris, 2007). The following participant explains one participant's actions for confirming his knowledge and patching up holes based on the feedback he got in the final test:

> When I have read something and get the questions and if I don't know the answers, then […] I go back into the material and check. And then you optimize, you don't need to go through what you already know. […] You browse to the weak points. And then when you check … that is, get the results, and then you get more confirmation: am I weaker in some areas than I thought I was? If I have decided that I knew it, I don't need to check it. But you still have answered incorrectly. Then you are weaker than you thought, and then you of course go in and correct the answers again, and then you get it covered 100%, that you really learn the material. [12-2]

Another example of a knowledge patching strategy deals with mediation of meaning between multimodal sources of information. Some participants searched for a relation between text and image in order to build understanding:

> I'm reading it through fast at first, and then I'm looking at the images, and then I'm reading it another time in order to get a relation. [04-1]

After the first scan of text, this participant was looking at the images. He was patching together pieces of information (text and images), then he was repeating the text again to

adequately understand the relation between the different pieces of content. He was focused on collecting all the multimodal pieces of information in order to build his own knowledge.

Information elaboration

Elaboration helps learners store information in long-term memory by building internal connections between new information and prior knowledge (Pintrich et al., 1991). In order to understand the content, some participants were discussing the material and elaborating on the information in a speculative way. They were trying to see how the pieces of information fit together and make sense of the material.

> I had some difficulties on this page. What do they really mean? This is ok for all; according to paragraph 11… all engine types on [engine name]. I guess… but the red markings indicate compatibility and the black markings indicate half compatibility. Or how should you interpret this? [01-1]

He was elaborating on the information without having enough prior knowledge to relate it to; he was speculating about the content. Another participant said:

> I don't know… maybe it's mechanical … but I don't understand what it means by this free assembly. Ok, free assembly: probably means that it's flexible, that you can freely put it in the way that it fits, but … probably… [09-1]

He was also elaborating on the information in a speculative way. If one has more prior content knowledge one is able to elaborate it in a more targeted way. This was evident in how some participants related the information to their own prior knowledge of similar matters. The following statement is an example of this:

> […] when the pipe becomes longer it affects this [he explains details] […] I learned something new there. […] This was new. I have never thought about that before. On our engines this is the same length. [14-2]

He was elaborating on the information in a targeted way based on his prior knowledge of similar engines. Information elaboration also involved how the content fits into the participants' own work duties and how it can be related to how things work in real life.

Critical thinking

Critical thinking is being able to use knowledge in creative and flexible ways, for instance applying new knowledge to situations in everyday life. It concerns being able to see multiple perspectives on an issue, and evaluating evidence presented, while being aware of the fact that it might not be the whole story. A critical thinker understands that there may be more than one correct answer to a question, and forms opinions based on evidence, although appreciating that others might disagree (Vanderstoep & Pintrich, 2003). Hence, being critical is to question the material for different reasons. This was represented by how participants related the content to their prior work experiences or usefulness of the information in reality. For instance:

If they say it's not relevant, why then do they include it here? [...] In my job we do it like this [he explains], [...] and that makes this much longer than this one here. [01-1]

He compared the information to his own work experience, and based his criticism on this prior knowledge. Another participant said:

I think I even disagreed with some of the things that ... the answer that should have been correct was not correct in my opinion. [04-1]

This participant further explained:

I have been dealing with this [...] now for our engine types. And there are some differences. And by experience you have maybe learned something about it. [04-1]

Another participant was critical about how the content would actually be relevant in reality:

Yes, I think that was a good thing, that you see from this e-learning course ... you can see the main principles. But then you start to question if these main principles are important in reality. They are important in the course to pass the test. But are they important in reality when the customer wants to buy? I don't think so. [07-1]

Comprehension through variation

Many of the participants commented on how emphasis on variation made the content easier to understand. Seeing differences and variations, alternative ways of doing things, illustrations of a right way and a wrong way of putting something together, etc. increased their understanding. Also having multimodal presentations illustrating the same thing (photo plus diagram) helped the following participant [17-2] understand:

These photographs over there..., so you can see how it works. I wouldn't have understood if I hadn't seen the photograph first.
[Interviewer: So from the photograph you understood the drawing?]
That's what I did. I went back, and it said [...] and then I went back and forth and back and forth, to see, ok, that was the pipe that was being referred to in the diagram [17-2]

This is also an example of patching information from multimodal sources. Another participant said:

I didn't understand this first one at all. [...] It's not clear enough to tell what has been before and what was after. I mean, what has changed. [08-1]

He requested more emphasis on the differences between solutions, since he felt that this would have been a better way for him to learn.

Comprehension monitoring

Monitoring activities assist the learner in understanding the material and integrating it with prior knowledge (Pintrich et al., 1991). According to prior research, it includes

tracking of attention in the learning situation, self-evaluation that is aimed at understanding the material during the learning process, monitoring comprehension of a lecture, and certain kinds of test strategies. For instance, self-evaluation indicates student-initiated evaluations of the quality or progress of their work (Zimmerman, 1989). Another strategy called *Keeping records and monitoring*, identified by Zimmerman, includes student-initiated efforts to record events or results (ibid, 1989), which is also applicable in this category. In the present study, it was obvious that one essential part of the learning process involved how participants monitored their understanding and resolved cognitive conflicts and questions they had regarding the information presented in the course. This was done either before, during or after the actual course work. *Cognitive preparation* was a strategy to prepare their thinking about the content before they started out in the course work. During the course work the participants used various ways to *practice and repeat* information, as well as activities for *clarification of content* whenever they were faced with a question about the course material. They also discussed *note taking* as a comprehension monitoring strategy. *Self-testing* was one way they checked their level of understanding, while *meaning negotiation and social feedback* was not an option in this course, but still discussed by the participants. These strategies are described in the following.

Cognitive preparation

Cognitive preparation involved the cognitive actions that participants took to somehow prepare for the content and adjust their thinking to increase learning. This had to do with their metacognitive awareness and regulation. Two such examples are reflecting on how to think about the subject beforehand, or preparing by formulating questions in order to better understand. The following excerpt illustrates both of these examples:

> It's good to have some guidance in your mind, what you think in advance about what would be the content of the whole course, then you know it in your mind when you go through the whole text, and … so you know what your attitude towards this should be, what they would like you to learn, and if you need to raise some questions in your mind to yourself, to make it easier to understand. [04-1]

This participant described in another sequence how he did this hands-on by scanning a page in order to form a first impression of the content before reading more carefully. He explained his reading strategy like this:

> I'm reading it through fast at first, and then I'm looking at the images, and then I'm reading it another time in order to get a relation. [04-1]

This excerpt also illustrates a knowledge patching strategy (see comprehension strategies), in which the participant was using multimodal representations in order to increase understanding. Hence, comprehension strategies and comprehension monitoring strategies are interwoven in the same learning process.

Information clarification

Information clarification involved how the participants tried to resolve cognitive conflicts and questions they had regarding the content. It concerns problem-solving from a comprehension perspective. Ways to do this were, for instance, rereading to get an overview and/or comparing information from multiple sources. One participant was going back, but still not sure whether he could find the right answer. He was trying to get an overview of what they meant regarding an issue he did not quite understand.

> I almost could not get an overview of what they really meant here. It was unclear. [...] And there were questions too that were a little bit unclear. […] I was not sure that I could get the right answer although I went back and looked. [02-1]

Similarly, the next excerpt shows how one participant was struggling to understand the information presented by rereading and comparing with questions:

> I think this was the difficult part for me. I had to read it a couple of times, and I still didn't understand it. When I compared this to the questions, because there was one question related to this that was very difficult, for some reason I don't know why. [08-1]

Another participant had skipped all the links in the course modules so far, but at one point followed a link all of a sudden. He [09-1] explained:

> I think I enlarged this one.
> *[Interviewer: This is the first time you followed a link, actually.]*
> Yeah. Cause it was such a small picture that it was not … I have no idea what it means. [09-1]

He did not see what the photo represented and tried to find that out and clarify the information.

Practice and repetition

Reciting or naming items to be learned by using working memory has an effect on attention and the processes involved in acquiring knowledge. However, according to Pintrich et al. (1991) it is not a strategy for integrating information with prior knowledge. Two of the strategies defined by Zimmerman (1989) fit under this heading: Reviewing records, and Rehearsing and memorising. It includes student-initiated efforts to reread notes, tests, or textbooks to prepare for class or further testing, or efforts to memorise material by overt or covert practice. Repeating text or the practice questions were common strategies for the participants to monitor their understanding. For instance, when one participant failed the final test, he went back to check the information in the course material:

> I went back just to go through it one more time, just to check if I had read something wrong, for instance. [05-1]

Another participant reflected on the significance of the practice questions as repetition after each module in the course:

> I like those intermediate practicing things after each thing [module]. Because it's easier to get a small amount of information, and then repeat and then go to the next one. It suits me. [08-1]

The next excerpt shows how one participant was repeating the content as a reading strategy. This could also be defined as a cognitive preparation strategy, as the person is describing how he builds up the process of understanding by focusing on different parts of the text, thinking it through, and finally repeating as a way to monitoring his understanding:

> Yes, I read it [the headings], then I read the text, and then I read the text one more time, and then I read and think through what they have said. [...] I first want to read everything so that I know what it is all about. I want to get everything. And then I can read again and understand [...]. [16-2]

He is also illuminating his information sequencing strategy by describing the order of attention he is giving to parts of the content for the purpose of increasing his understanding. The next excerpt is rather expressing a cognitive need instead of a strategy. However, it shows that his cognitive strategy would have been to repeat the practice questions until he had learned the material.

> I need some more exercises if I should do some learning like this. [09-1]

This participant of Group 1 was aware of his cognitive needs for repetition and monitoring his understanding and learning, although he was not allowed to express them fully due to the limits of the course environment. There were also reflections on how the e-learning environment presented different affordances and constraints in comparison to a traditional training course.

> But tomorrow, when I'm at the office, I cannot go back anymore. That's difficult. [...] Ok. I can do the training again. But that's not what you normally do. If you have traditional training, you don't go and make the whole training session again. You take the file where you have the notes and everything, and have a look at that. [03-1]

This participant felt that he missed the opportunity of looking at his own notes as a quick repetition and thought that going through the whole course again would be too much.

Note taking

As indicated in the previous excerpt, the participants felt that e-learning was not meant to be combined with note taking as a strategy for learning. However, one participant [08-1] still took some notes in order to remember better.

[Interviewer: You made some notes also.]

Yes. But I don't think it's the point of this kind of e-learning to make any notes. My point is that everything is there, and you don't need anything else other than the computer and yourself. You don't need to do anything else.

[Interviewer: But you did anyway.]

Yes. I did it, because, I was just… I wanted to… I think that was the way I can remember something better. But I think there should be some other way to do it. [08-1]

He expressed that there need to be other ways of learning the information, but he found no other way. Another participant missed the note taking part. His suggestions were:

You can make a note, and then you can have a hyperlink somewhere, so that you can go afterwards if you need it, and have a look at your comments and so on. It's normal when you have traditional training that you have a file where you have your training material. Then afterwards you can have a look at it and your comments. But here it is disappearing somewhere, and I cannot see it anymore. I have to go through the whole thing. Of course, it is different. This is self-paced e-learning, but still I think it [note taking] is useful. [03-1]

Self-testing

The participants used the resources available, such as the practice questions, to test their level of knowledge. As a response to the question of whether he always took the practice questions, one participant said:

Yeah […] They're good because then you know what you've learned. It doesn't matter if the answer is wrong or right. If you get it correct or not. But you know. [17-2]

This person stated that he felt that the practice questions helped him check whether he had understood the content or not, and for that reason he took all the practice questions available. He used the practice questions to confirm his understanding. This participant was part of Group 2, who took iteration 2 of the course including the improved feedback on practice questions. Another participant agreed with this:

I thought it is better to take all these practice questions, because then you see it if you understand it or not. And you immediately get the answer if it is ok or not. [04-1]

He took all the practice questions in order to check whether he knew the answers, trusting the environment to give him the feedback he needed.

Meaning negotiation & social feedback

The concept meaning negotiation refers to monitoring understanding by learning about other people's opinions and thoughts. This is an interactive negotiation process about meaning and knowledge, which functions through feedback and communication (cf. Kress & Selander, 2012 on meaning-making). Although the e-learning course did not provide options for communicating with other course participants or trainers/tutors, many participants expressed a need for opportunities to discuss with others, and through communication about the topic monitor their understanding. The following

participant highlights the importance of using socially situated meaning negotiation to develop a deeper understanding, especially as the subject matter is prone to lack definite answers and single explanations to problems.

> Here you cannot … of course, you can think yourself, this is not working; this is not good. But you cannot check who is having the same opinion, is this correct or not. In that respect it would be important to have some link or, possibility to get feedback or whatever. Normally, when we're talking about technical things, there are always different opinions. [03-1]

Similarly, another participant expressed his view that listening to diverse opinions and communications about topics is beneficial, while being alone with only one's own thoughts is not very good for learning.

> During a class, there is more communication. You hear others' opinions at the same time. The others are also there. That is good. It's not like here, where you only have your own thoughts. I don't know if that is any good … [06-1]

This awareness of the importance of social negotiation of meaning is similar to what Susimetsä (2006) calls collective metacognition. This concept refers to the group's ability to monitor cooperative learning – how they know about learning together. Although the participants had no opportunity to engage in any sort of collective metacognition, they still knew about its usefulness for learning in the workplace.

Cognitive regulatory control

In the present study, cognitive regulatory control had to do with how the participants preferred a certain modality of content presentation; for instance, preferring text-based content rather than image-based illustrations. It also involved how they regulated attention and effort during their course work, how they prepared themselves cognitively beforehand, as well as how they tested the level of their learning during their course work.

Modality preference regulation

In the e-learning context there are often various multimodal representations of the content, which complement each other. A visual illustration may, for instance, aid cognition in understanding the content better. Some participants described how images helped them understand the text better, aided in recalling facts, or as one participant said:

> Images are good usually. I have a visual memory […] I remember a little bit from the text and a little bit from the image, and then you get a better holistic picture of it. [16-2]

This participant memorised and learned with the help of visual images. The excerpt also shows a knowledge patching strategy by using multimodal representations of the content, as he mentioned how he patched together information from different sources,

in order to reach a fuller understanding. Comprehension with the help of visual images was also discussed during interviews. One person commented:

> It kind of proves the text. So I can believe it better, when I have seen the picture as well. [08-1]

In his opinion, the visual illustration confirmed the reliability of the content. Hence, it helped him to better understand the content. Another participant also suggested that he learns better from images than from text:

> If there is a lot of text, so you have to concentrate on both [images and text]… then you look more at this … the picture […] That's how I do it […] because you get a better understanding from the image in my opinion. [01-1]

The reason he focused more on images was because he knew that he learns better from images than from text. In contrast to this, one participant described how he only relied on the text, as this was his preference for learning:

> I don't waste time to try to memorise images. I can't. I have learned to learn from text. If you understand the text content, then you understand. [12-2]

In this case, cognitive reliance on text is the source of his modality preference as a cognitive strategy for understanding the content.

Attention regulation

The ability to regulated one's attention is important for keeping up, for instance, concentration and effort, as attention is believed to "provide specific cognitive mechanisms that mediate self-regulation" (Hanif, Ferrey, Frischen, Pozzonbon, Eastwood, Smilek & Fenske, 2012, p. 104). The participants mentioned attention regulation in various ways, which reflected levels of awareness and attention regulating strategies. One participant said:

> I read the text first. If you go to the small pictures, then you don't focus on the text […] or you don't read so carefully. You know … this same thing in this one. [07-1]

This was interpreted as sequencing information: taking the text first where he thought he would find the key information. Why did he do this? He knew that he would read the text more thoroughly if he did not let himself become distracted by the image first. Hence, he expressed an awareness about his own learning needs and ways to regulate his attention in the best way. For another participant the attention regulation was not so much based on focusing on the key content first, as the one described above, but rather to simply follow his own interest.

> Sometimes, if the picture on the left hand side is more interesting, then I take a look at that first. [04-1]

His attention was drawn to things he found more interesting. Why did he do this? He was regulating his attention based on what interested him. In this instance, his attention regulation was linked to motivational regulation.

Effort regulation

Effort regulation is one of the most important learning strategies, and at the nexus of interaction between motivation and cognition. A good learner knows when to increase effort and persist in the task as well as when maximal effort is not required for success (Pintrich et al., 1991; Weinstein et al., 1987). The participants' effort regulation involved, for instance, their persistence in focusing on content until they felt that they understood it to a satisfactory level. Examples of this strategy were repetition of text and/or images until understanding was reached. Effort regulation was evident from how the participants discussed repetition of, and persistent focus on, content. The following three excerpts illustrate persistent focus on text:

> I didn't understand this … I had to repeat the text a few times in order to really understand it. [04-1]

> You can see that I have really read every single word, and tried to see what it is all about. [12-2]

> I had to read about ten times in order to understand it. [10-1]

The next excerpt shows how a participant kept persistent focus on a picture until he understood it:

> I had to keep looking [at the picture] in order to know what I was looking at. [14-2]

8.4   Cognition: Learning approaches

The fourth question targets how the e-learning context influences participants' learning approach with regard to their cognition. Thus, I refer to these as cognitive learning approaches.

> Research question 4:   *How does the design of the course influence the participants' cognitive learning approach?*

Their cognitive learning approach relates to their beliefs about what learning is and how knowledge is created, i.e., their epistemic beliefs (cf. Greene et al., 2010). The concept of cognitive learning approach pertains to the performance phase of SRL (cf. Puustinen & Pulkkinen, 2001), in which learners incorporate goals in their coursework, influencing how they choose to study the material. This can be compared to theories of deep and surface learning approaches (cf. Entwistle 1986; Marton, Hounsell & Entwistle, 1986; Marton & Säljö, 1976; Marton & Säljö, 1986), as well as achievement approach (Biggs, 1994; Richardson, 2000). The two approaches evident among the participants were

Memorisation for achievement and *Comprehension for application*. Or, rather, the first is what the participants adapted to in order to pass the test, while the other represents how some participants were striving for deeper learning in line with their epistemic belief. Excerpts show how these cognitive approaches were supported and/or induced by the e-learning environment, and especially the design of the evaluation of their learning by the final test.

Memorisation for achievement

Memorisation was accentuated and promoted by how the multiple choice questions, in both the practice questions and in the final test, were set up. Although the participants aimed at understanding the content in relation to their own work, they still had to revert to memorisation of details in order to pass the test. This was evident in how, for instance, one participant [06-1] kept on repeating a set of practice questions, ticking a variety of the multiple choices one after the other.

> [*Interviewer: We can see that you were repeating. Did you try to memorise these questions too, so that you would know them by heart?*]
> Yes … some, yes. But like this trial and error … If it had showed which were incorrect, it would probably have gone faster. [06-1]

This participant belonged to the first group without any feedback on practice questions. The lack of feedback made it almost impossible to know which of the answers were correct. His repeated trial-and-error strategy was the result of this lack of feedback. Another participant did not go back and retry the practice questions he got incorrect. Instead, he tried to remember which boxes he had ticked.

> I knew that I could go back, then I thought I would memorise a few choices, because in the final test I remember which ones I had chosen, and if it wasn't correct, then I maybe choose another one. [04-1]

He memorised the choices he had made on the multiple choice questions in order to be able to remember which were correct and incorrect for the final test. Remembering the order of ticked boxes could be seen as a support strategy to use whenever the memorisation of the content itself fell short. This is also apparent in how the next excerpt illustrates memorisation of correct answers:

> The technical intermediate tests [practice questions] help a lot in this case. Because it is the same questions repeated. You remember that this is the correct answer. [17-2]

The same approach was expressed by other participants regarding their thoughts about the design of the final test. For instance, while being asked what he thought about the final test one participant [09-1] said:

> Yeah. It was ok. But I think I didn't use enough time for the practice questions... it should have gone better […] I did not use enough time for the practice.
> [*Interviewer: So you take all the blame on yourself?*]

Of course, this is the kind of test, where if you have been practicing you can do it without any thinking […] Yeah. I remember. [09-1]

He felt he did not use the practice questions enough to remember them for the final test. His solution for passing the test would have been to memorise the answers so he would not have to think during the final test. Another participant [08-1] explained:

I just tried to find out what the correct answer is: ok, I don't know this, so just tell me what the correct answer is.
[Interviewer: So did you learn anything from that?]
Not really, maybe one or two questions, not more. Because when I go back and forth, it is also confusing; when you do it like this you can remember it for a while, and then you can think again, what was first, and what was second…
[Interviewer: So you didn't remember the content, you remembered how the answers were?]
Yes, the crosses. Exactly. I guess that's not the point of learning. That you just know where to put the correct cross. [08-1]

Based on his answer, it is quite clear that the test did not measure learning, as it was designed to do. All of these participants' reflections about the assessment of the course show their awareness about this fact and the discrepancy with their own epistemic beliefs about knowledge and learning in the context of the workplace. One problem with the test, which made the participants memorise the answers in order to pass, was the fact that the same questions were used in the practice questions in each of the modules, and then repeated in the final test. However, it is not the only problem with this kind of assessment style. Research has shown over and over again that assessment style has impact on whether students adapt to a surface, deep, or achievement approach towards learning (e.g., Biggs et al., 2001; Richardson, 2000). In this case, the results also clearly showed that the participants started to focus on "the sign" instead of "the signified" (cf. Marton & Booth, 1997) because of the assessment style. I define it as surface learning and call it memorisation for achievement.

Comprehension for application

Comprehension for application refers to the participants aiming to understand the content so that they would be able to apply it in their own work. The discussions regarding this clearly showed that it was essential that the content was relevant to their work situation in order to facilitate their ability to remember it. Furthermore, too many details to memorise were seen as something negative and counterproductive, which usually is referred to as extraneous cognitive load from an instructional design that does not adhere to the cognitive limits of our memory (Leahy et al., 2004). The next excerpt illustrates how one participant memorised what was needed, as well as emphasizing that he focused on understanding the content through logical thinking. He [16-2] expressed how his goal-setting was important for the approach he chose for learning:

Usually I don't write down any notes […] I remember instead.

[Interviewer: Do you memorise it?]

Yes, but it depends. This was probably just short term. So I probably forget this faster. But if you write notes and reflect, then I would probably remember better, and remember for life. But that wasn't my goal for this, to remember for life. But if it were something that I work with, then I probably would have written notes […] I learned, but I also memorised, of course. But […] I learned in the way that I could think logically, not only from memory, but because it was logical. [16-2]

This participant further makes a distinction between understanding the content for the moment for passing the test (cf. memorisation for achievement approach), and learning and remembering for life in case he needs to apply it in his work. Likewise, one participant emphasized that it is more important to focus on understanding the "whole picture" than to memorise details for the sake of memorising. To see the whole picture of something to be learned can be compared to a deep approach to learning (cf. Marton & Booth, 1997; Richardson, 2000). This participant had expressed earlier that he had tried to memorise which boxes to tick in order to pass the test. However, the following statement clearly shows that his epistemic belief was not congruent with such an approach towards learning.

The whole picture is more important than just the small details. If I need small detailed information I can pick it up later on. If I now started to study more information, this and this engine needs this package… then I can probably remember it for two days. But if I don't need that information I will forget it for sure. [08-1]

He also pointed out that there is only a short term benefit in memorising details, and it does not last if the information is not needed for application in real life. In another sequence, he further felt that there was too much detailed information to remember in a diagram, and although he understood it, he [08-1] was not able to remember it, as it was not relevant for him to learn this kind of information:

I would make this more clear, probably… that …

[Interviewer: Do you think this diagram or table is confusing?]

Yes, somehow. When you check this, ok […] it's very difficult to … you can see it, read it, and understand it. But you don't remember it. I don't know what I would do to change this. … But it's difficult to say, because if I was a sales person, then I would probably be more interested to know this Z40, this and this. But from my point of view it's not relevant, so … [08-1]

He emphasised that the application of knowledge is the key to be motivated to learn detailed information, as well as to be able to remember it. He is aware of his own cognitive limits and adjusts his learning both to this fact, as well as to the learning goals he sets for himself in relation to the value the content has to his work (cf. Pintrich, 2005 on task value). To be self-regulated in their learning (Brookfield, 1996), as well as having a pragmatic approach towards content (Knowles et al., 1998), are common attributes among adult learners.

8.5   Affect: Contextual triggers and user experience

The fifth research question targets the participants' user experience and how their emotions were affected by the e-learning course. Interpretations of the subjective formative data from stimulated recall interviews were used to answer this question.

Research question 5:   *What are the contextual triggers and inhibitors of positive and negative emotions experienced by participants of the e-learning course?*

This phase of the analysis targeted the emotional aspects of the participants' e-learning experience. User experience, as discussed within the field of HCI, involves the hedonic aspects of the experience while using a product (Hassenzahl, 2010). According to Egloff's team of researchers (2003), it is reasonable to make a differentiation of positive emotions by separating joy, interest, and activation. By exploring these emotions represented in the data, while also being open to others, it was assumed that the results would point to whether there were factors in the course environment that provided a hedonic quality to the e-learning experience. However, negative emotions were also interesting in the sense that it was presumed that these would highlight what was lacking in the environment. The participants' affective states during their course work were found to be an integrated part of the learning process. These included both positive and negative emotions triggered by various factors during their course work. These are presented in the following.

Triggers and inhibitors of positive emotions

This analysis was partly guided by Egloff et al.'s (2003) differentiation of positive emotions, with special emphasis on joy, interest, and activation, and how these emotions were prevalent in the interview data. However, the data were also approached inductively in order to find other positive emotions related to what the participants were doing in their course work. Both triggers and inhibitors of four positive emotions (curiosity, feelings of freedom, interest, and activation) are discussed below, as well as presented in Table 32.

Table 32 Triggers and inhibitors of positive emotions

Positive emotions		Triggers and inhibitors
Excitement by novelty	triggered by	- New learning format
Feelings of freedom	triggered by	- Choose your own time, space, and pace
Interest	triggered by	- Look-and-feel of the interface - Colours, animations, simulations, video - Images, graphs, links, schemata, formula, pictures - Clear objectives, examples, exercises - Content related to their own work situation - A personal investment of some sort - Receiving some kind of reward
	inhibited by	- Scroll-down feature - Plain text in a box with white background - Slow-functioning and complicated interface
Activation	triggered by	- Pictures, simulations - Interactivity-based features - Real life visualization of content - Feedback dialog generated by own actions - Content that stimulates you to move forward - Content that stimulates you to think - Practice opportunities and challenges
	inhibited by	- Too much text - Irrelevant content for own work

Curiosity by novelty as positive expectation

During the interviews the word joy was not mentioned in relation to the course work. However, there were some comments about curiosity about taking the e-learning course as a new format of learning, which for some felt exciting to be a part of.

> And it was interesting, because I have never done an e-learning course before this. [17-2]

> Time went fast, so that means that it wasn't boring. It was exciting. Perhaps because it was something new. [05-1]

> I thought it would be very interesting to learn in another way than to read in a book. [16-2]

This can be compared to feelings of novelty, and positive emotions triggered in a novel situation. Therefore, I define this feeling as Curiosity by novelty. The novelty aspect is similar to Kikuchi's (2006) Japanese study, which found novelty to be related to positive feelings of curiosity. This kind of curiosity was not only discussed in relation to the new type of learning solution, but also to the content as such. One participant expressed his interest and curiosity in the content, which was new to him:

Yes, I read this [course introduction]. Then I noticed that these are [...] and not our types of engines. So that was rather interesting. [14-2]

I interpret the feeling of curiosity by novelty as closely related to excitement. According to Parrots (2001), excitement is a tertiary emotion stemming from joy, while Douglas-Cowie and her team of researchers (2005), investigating emotions for the purpose of emotion-oriented systems design, include both joy and excitement in the "Positive and lively" category. In the context of this e-learning course, I interpret curiosity by novelty as a feeling of excitement based on positive expectation. However, this novelty might also be ambivalent by involving some anxiety in addition to excitement, as the following participant explains:

It was new […] exciting, but a little bit unpleasant/uncomfortable37. [05-1]

Feelings of freedom

The fact that e-learning provides the opportunity to choose one's own time, space, and pace for learning was a trigger of positive emotions for some. One comment was that it created a feeling of freedom, which can be compared to the category "Positive and quiet" as described by Douglas-Cowie et al. (2005). This category includes emotions such as calm, content, relaxed, relieved, and serene. However, the feelings of freedom-category also involve another important aspect pertaining to feelings of autonomy (Deci & Ryan, 2000), which is an important ingredient for enhancing and facilitating intrinsic motivation, by giving the learner control and agency over his/her own learning situation, and thus, also SRL. The following excerpt illustrates an expressed feeling of freedom as it relates to autonomy:

I think that that's easy. Because you can just do it for a moment. And if you feel like, let's take a pause. [..] It's easy, and you can do it at your own pace, if you feel that ok, you got it, but you can go back and check again what you have thought …ok, then I can come back later and go to the next thing. It's like nobody is trying to push you through a sequence. It's not a fixed time schedule. If you have a lecture for one hour, then the lecturer has to go through it, he cannot go back. Maybe if it's … this is easier. Then I can decide what to do. I can jump to the last chapter and then the first chapter again. [17-2]

One participant saw the freedom as an opportunity to be able to follow his own motivation.

Yes, it is beneficial that you can do it whenever it suits you [...] It gives you the freedom to do it whenever you are motivated, regardless of whether teachers are present or not. [12-2]

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37 Translated from the Swedish word "obehagligt"

Interest

The feeling of interest is at the core of being intrinsically motivated for something (Deci & Ryan, 2000). In the data, both contextual (digital interface) and content-based (information to be learned) factors were found to either increase or decrease interest in the course work. The content-based factors discussed by the participants as increasing their interest were clear objectives, examples, and exercises. Similarly, the addition of multimodal presentations seemed to increase the participants' interest, such as when text was accompanied by schemata, formulae, pictures, and graphs. The use of multiple representations of information is suggested for learning design (Peters, 2013). Features that were discussed by the participants as increasing their interest were colours, animation, simulations, as well as images, links, graphs, and video. These were either features within the course itself, or visualized by the participants as factors that would have helped them to keep up their interest (video and simulations were examples of the latter).

> I guess it is good to have pictures and all kinds of graphs. [...] it doesn't make it so tough, like if it's just text with small letters, then it's boring to read. So it's good to have, and some video clips or whatever. [04-1]

Another thing mentioned was that interest increases if the look-and-feel of the interface is pleasing to the user. The first page is important as an interest-builder. This can be defined as interest triggered by aesthetics. Research has shown that aesthetics make an interface easier to use (Norman, 2003; Peters, 2013), and the participants seemed to link it to interest as well. There were also a number of external factors that were mentioned as important for keeping up interest. Among these was the most frequently discussed factor: the fact that the information presented in the course should be related to their own work situation in order to be regarded as interesting. This is congruent with earlier research on adult learners (cf. Brookfield, 1996; Conlan et al., 2003; Knowles et al., 1998). Examples of this, highlighted during the interviews, were the need for the information in the participants' own work, new information in relation to their own work, information that is close to their own work, but presenting a variety to what they already know, or that the course gives a concrete advantage in improving their own ways of working. In contrast to this, they also mentioned that confronting information irrelevant for their own work situation decreased interest in the course. Another example mentioned by the participants was that it is easier to devote interest in something if they have to make some sort of personal investment in the course, or if they receive some kind of reward (certificate, higher salary, etc.). The participants believed that their learning would benefit from making a commitment to learning, as well as by being extrinsically motivated (cf. Deci & Ryan, 2000). There were a number of factors which inhibited positive emotions. These related to both content and the e-learning context as such. Content-based factors decreasing their interest were irrelevant data in tables or graphs, too many details displayed at once, or too much information. These are examples of extraneous cognitive load placed on the learners by the instructional design and how the information is presented (Leahy et al., 2004). When the design pushes the

limits of the learners' cognitive ability, their interest in the material decreases. Furthermore, there were contextual factors that decreased their interest, such as scroll-down features (they feared that there would be too much to read, and therefore made them apprehensive about what was to be found when scrolling down), plain text in a box with white background, as well as slow-functioning and complicated interface, which relates to usability issues.

Activation

Activation was mentioned as an essential factor for maintaining interest, keeping up concentration, as well as regulating effort in the course work. The opposite was also discussed, as one person said that if the course does not activate him to a certain degree, there is a risk that he will not take the course seriously and/or lose interest in it. Triggers of activation were pictures, real life visualization of content, simulations, feedback dialog generated by own actions, content that stimulates one to move forward, content that stimulates one to think, practice opportunities and challenges, as well as interactivity-based features. One participant reflected on the levels of interactivity in the course:

> At least when I was doing the question and answer series. Then it was … asking me something … and then I am getting a check that, ok, if my answer is correct or not. Then I get a feel for … what I have understood, is it really … has it entered or registered, or is it just … [17-2]

In contrast to the triggers of activation, the participants were less activated if there was too much text to read, and if the content did not feel relevant to learn for the participant.

> I thought I was left too passive. I missed sound. There should have been more auditive and kinaesthetic options – to be able to click on more things. This was more like e-reading than e-learning. [13-2]

Triggers of negative emotions

A variety of negative emotions could be detected from how the participants discussed their course work: frustration, confusion, and anxiety, as well as a feeling of loss of self-efficacy. These are discussed with regard to the factors that triggered the emotions (see Table 33).

Frustration

Feelings of frustration were triggered by computer problems (hardware, software), content (lack of transparent content overview, ambiguous content), features of the e-learning environment (scroll-down feature, disturbing animations, limited link-possibilities between final test feedback and content), lack of feedback and assistance (live teacher/trainer, feedback on actions), and the need to adapt cognitive preference for learning (cf. learning style) in accordance with test requirements (e.g., questions that require memorisation of details).

As soon as you see a scrollbar, you think: text, a lot of text to read, and that is tedious. [14-2]

You know … You don't have the opportunity to ask. If you would like to get an immediate response on [something], the teacher can reply […]. But here, you have to take Back and Continue, and then you don't find your way back, and then you have to take all those questions again, or, that is really too frustrating. [01-1]

Table 33 Triggers of negative emotions

Negative emotions		Triggers
Frustration	triggered by	- Computer problems
		- Lack of transparent content overview
		- Ambiguous content
		- Scroll-down feature
		- Disturbing animations
		- Limited link-possibilities between test feedback and content
		- Lack of feedback and assistance
		- Memorisation for final test
Confusion	triggered by	- Indistinct headings
		- Superfluous details in images
		- Density of information to memorise
		- Lack of prior content knowledge
		- Lack of navigational instructions
		- Ambiguous instructions
		- Ambiguous navigational features
Anxiety	triggered by	- Confronting a new learning format
		- Lack of transparent navigation structure
		- Lack of transparent content overview
		- Error message while navigating the environment
		- Time pressure in the final test
		- Answering wrongly in practice questions
Insecurity from decreased self-efficacy	triggered by	- Difficult vocabulary

Confusion

Feelings of confusion were triggered by both content (indistinct headings, superfluous details in images, density of information to memorise, and lack of prior knowledge of content), and instructional design of the environment (lack of navigational instructions, ambiguous instructions, and ambiguous navigational features). One participant expressed how he felt an overwhelming cognitive load through too much information:

I also tried to mark these things on paper, because they were kind of difficult for me. And here, when we have a lot of different models put into the text. That is confusing. [08-1]

Here, I read this another time. I didn't really know [...] in which direction I should go. [14-2]

Anxiety

Feelings of anxiety were triggered by confronting a new format for learning (e-learning), lack of transparent navigation structure, lack of transparent content overview, error message while navigating the environment, time pressure in the final test, as well as answering wrongly in the practice question section. Here are two examples:

> The clock was ticking and I started to panic. [12-2]

> I was afraid to navigate and get lost and not be able to get back to the same place – especially since there was a test. [02-1]

Insecurity from decreased self-efficacy

The following participant expresses how the text, if it becomes too complicated, influences his feelings about his ability to learn, which is usually referred to as self-efficacy (e.g., Bandura, 1986). He experienced feelings of insecurity from decreased self-efficacy.

> […] they use lots of jargon even for simple things. Makes you drowsy, maybe if they use heavy words, in your mind you start to think that this looks difficult, you might not be able to digest it. [17-2]

9 Discussion

This study has explored how corporate e-learners manage a self-paced e-learning course; more precisely, how the design of the course supported and facilitated participants' self-regulated learning (SRL). Their actions and intentions were targeted in relation to areas of SRL: behaviour, cognition and affect. Two iterations of the same course were subjected to study, involving two groups of participants (N=17). I will discuss the results with regard to the changes made to the second iteration of the e-learning course design, and how the participants' SRL activities changed when the e-learning context was, albeit slightly, redesigned. However, not all research questions pertained to this educational design research perspective of comparing course designs. As participants' SRL was influenced by more aspects than just those that were changed in the second course iteration, also a general focus on SRL in relation to the course design was of interest.

In this chapter, I will, firstly describe two figures illustrating the results categorized in relation to the how (actions) and why (intentions) perspectives, as well as how preconditions and constraints are important factors impacting SRL. Secondly, the results are discussed in accordance with the areas of SRL, as mentioned above. This can be summarized as *behavioural regulation* (how participants were acting and why); *cognitive regulation* (how they were thinking and why); and *affective regulation* (how they were feeling and why). The separation of SRL into areas of thinking, feeling and behaving is in most situations artificial and does not portray learning experiences as the holistic, synchronous, and dynamic experiences that they are. However, it allows for an exploration of the influence of the design from three perspectives. This informs e-learning design on a broader plane than simply seeing learning as something merely cognitive, which seems to be an enduring myth in the field of learning technology design (Peters, 2013).

Participants' actions and intentions

The main research question was: *how does the design of the e-learning course influence participants' self-regulated learning actions and intentions?* I begin this concluding discussion by presenting two figures (Figure 16 and 17) that illustrate the results pertaining to participants actions (how) and intentions (why) in accordance with the main research question. These figures emanate from the structure of Figure 14 in Chapter 4. The purpose is to visualize the variety of actions, as well as the variety of intentions that participants used for managing their learning within this particular e-learning course.

The two figures (Figure 16 and 17) need a brief introduction. Firstly, the contextual factors in Figure 14 are not visual in the two new figures, but still implicitly present in the form of the black thin frame with the rounded corners. Secondly, the results are divided in accordance with the how and why-questions and how these are related to the

areas of SRL – again visualized as dynamic cogwheels. The use of cogwheels as a metaphoric visual is an attempt to illustrate the innate dynamic character of SRL. Furthermore, there are no boundaries between the categories of the results in the figures, as I find that the micro-level processes related to the areas of SRL at times overlap. Thirdly, the outer frame of both figures is an addition to the original Figure 14 and represents part of the results of the study. These will be described below as preconditions and constraints.

Preconditions and constraints: The factors placed in the outer grey frame of both Figure 16 and 17 represent preconditions and constraints influencing participants' SRL activities. The study showed that there were several preconditions, as well as extrinsic constraints and limitations which impacted how participants managed the e-learning course and, thus, influenced the dynamics of their SRL. The preconditions that influenced participants' SRL were *prior content knowledge, prior context experience*, and *the norms of the prior educational culture* they were familiar with. These preconditions set the ground for interest in the content, habits of managing the digital interface, as well as expectations on rules of conduct related to learning and being assessed for learning. Furthermore, various *constraints* impacted and caused limitations for e-learning management. Time, environmental, and physiological constraints were found to influence the participants' choice of actions for learning and managing the e-learning course. These were, in one way or other, either pertaining to the content of the course, or to the context of the e-learning environment, that is, the digital interface.
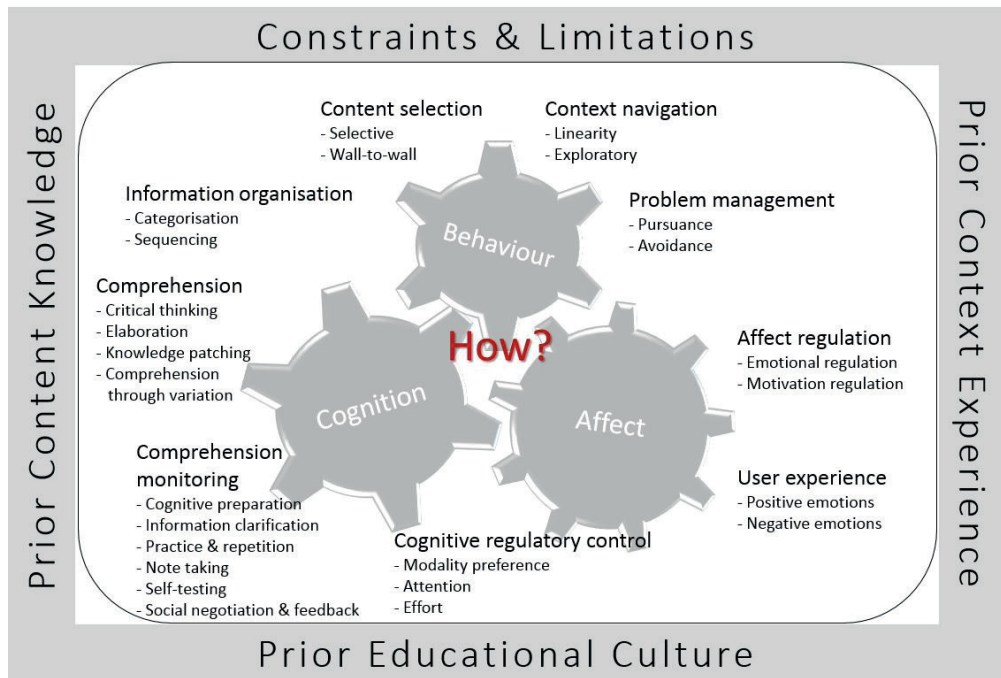
Figure 16 Areas of SRL and related actions and experiences.

How? Participants' doing and being: Doing refers to behavioural strategies or actions for managing the content and context, cognitive strategies for managing the learning, and strategies for regulating affect, such as balancing emotions, maintaining motivation and volitional control throughout the course work. However, affect is more than motivation, which is a concept for describing drives. Affect as an area of SRL in e-learning environments is also an experience of the presence within the context. Thus, I refer to the concept of being, in this case, as the contextually induced user experience conveyed by the participants during the stimulated recall interviews. It is a mix of both positive and negative emotions as a part of their total learning experience. In Figure 16, the micro-level SRL processes found in the present study pertaining to the how-question, are presented. The categories will be further scrutinized in the next section of this chapter. But before that, I will shortly describe Figure 17.
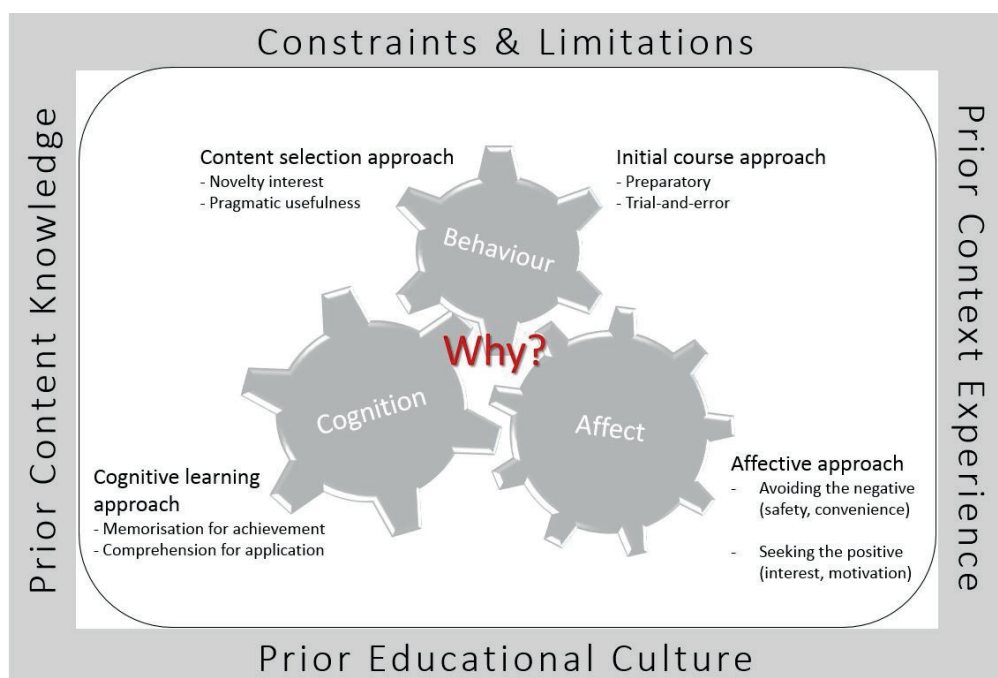
Figure 17 Areas of SRL and related intentions for learning.

Why? Participants' intentions: Why the participants acted in a certain way during their course work was interpreted as their intentions. The micro-level SRL processes found were categorized as variations of approaches to acting. These categories are, similarly to the previous figure, listed in relation to areas of SRL in Figure 17. In earlier research of, for instance, McKeachie, Pintrich, Ruohotie, DiPaolo, and Susimetsä, to name a few, the why-question is usually referred to as the category of motivation (cf. the MSLQ questionnaire described in 4.2.4.). Motivation concerns our drives to do something, as well as goal-direction. The concept of goal-direction does to some extent indicate

conscious planning. However, participants' intentions for acting did not always derive from a conscious level. I would argue that intention is built on both reactions and reflections. During the analysis, I have explored the why-question also beyond the concept of motivation, investigating participants' affective experience more broadly.

In reality, the categorical concepts presented in Figure 16 and 17 are operating synchronously to create the dynamics of SRL. This can be seen in the next section, in which the results are presented in detail.

9.1 Behaviour regulation

How the participants took actions during their course work were explored both by observing their overt behaviour and by interviewing them about their choices of behaviour during a stimulated recall interview. In the following, I describe my interpretations of the micro-level SRL processes pertaining to *observable actions, content selection, context navigation*, and *problem management*.

9.1.1 Behavioural actions

The first research target was overt SRL (behaviour) for e-learning management with regard to how the participants' behaviour was related to the course context and content. I was interested in *observable differences in how participants, subjected to the two course iterations, take actions for learning and manage the course*. The results are based on interpretations of observational data from screen recordings and eye tracking.

Observable actions: The most obvious difference between how the two groups of participants managed the e-learning course from an overt behavioural perspective had to do with how they manipulated the course to benefit their own learning. In Group 1, there were two kinds of e-learning management behaviours that stood out: *instruction-directed navigating* and *self-directed manipulating*. The feedback given to Group 2, taking the second iteration of the course, was the trigger for participants to start exploring the course material and e-learning context in order to fill their gaps of knowledge. This kind of e-learning management behaviour was therefore called *feedback-directed exploring*. The feedback – although minimal as such – gave them a means to reflect on where their knowledge gaps could be. The fact that feedback is important is nothing new. It has been discussed both from a HCI design perspective (Dix et al., 1997; Shneiderman, 1982) and from an educational perspective (Azevedo & Aleven, 2013; Larsson, 2001; Mason & Bruning, 2014; Tolboom, 2012). What the results in this study suggest is that feedback can be regarded as the tipping point for successfully managing the environment by allowing the participants to identify their limits of content knowledge, as well as exploring the content in a more targeted fashion in accordance with their own learning needs. Even the limited amount of feedback added to the course seemed to help participants SRL by giving them options to assess and reflect on their learning. Hence it was a tool for regulating both the context and their

progression with the learning tasks (cf. Azevedo & Aleven, 2013; Sims-Knight & Upchurch, 2001). This will be discussed more closely in section 9.2 on cognitive regulation, and especially regarding its subcategory of comprehension monitoring. The abovementioned behavioural observations are based on interpretations of the recordings of their course work. However, such interpretations are subjective and need to be triangulated with other data in order to gain credibility. Therefore, I will repeatedly come back to the issue of feedback and how the participants have discussed this aspect during the stimulated recall interview. But first I will describe the rest of the behavioural strategies, which derives from targeting their covert SRL of e-learning management.

Context navigation: The course content and the digital context are two different layers to be managed. Context navigation pertains to how participants managed the later. Two types of context navigation found were linear and exploratory navigation. Participants using a *linearity* strategy took the course modules in accordance with the pre-set structure of the instructional design. They adhered to the rhythm of a "Next-button" navigation pattern as the path through the course. In contrast to this, the participants using an *exploratory* strategy for context navigation were more self-directed in their choice of path. This category equals the earlier identified self-directed manipulating behaviour found in the observational data, while linearity represents the instruction-directed navigating behaviour. The difference that feedback had on their behavioural actions, as interpreted from the observational data, crosses over into the area of cognition within the framework of SRL.

Content selection: During the interview, two categories were found related to how participants reflected on their choice of content: *selective* and *wall-to-wall*. A selective strategy was used by some participants who selected only the content of their own choice and disregarded the rest for different reasons, for instance, based on interest or pragmatic need for information (cf. content selection approach in Figure 17). They had an inner self-direction for their choice of content. The wall-to-wall strategy contradicted the first strategy as participants using this strategy discussed their choice of content in terms of covering everything in the course, either for intrinsic or extrinsic reasons, or simply by habit of using a computer-based environment.

Problem management: How the participants dealt with problems they faced (either related to the content or the context) was also categorised as behavioural strategies. Here, two different strategies were found: *avoidance* and *pursuance*. For instance, the three participants of Group 1 who showed high levels of self-directed manipulating strategies were all good examples of participants using a pursuance strategy when faced with problems (in this case, lack of feedback on actions). An avoidance strategy involved actions such as dodging problems whenever they occurred. These were either software or hardware problems, but also content-related problems having to do with comprehension. The latter is an example of how the areas of SRL can be connected during the learning process; comprehension difficulties (cognition) cause negative emotions (affect) and results in avoidance (behaviour). Hence, problem management

strategies were closely related to affect regulatory abilities, as well as to how the design supported the comprehension process. Efklides (2011) describes the importance of acknowledging affect as an essential aspect of the metacognitive experience, which is influencing learners' metacognitive monitoring (e.g., Azevedo et al., 2013). Feedback that facilities, for instance, judgements of learning, which is described as one metacognitive monitoring strategy, scaffolds learners in finding their gaps of knowledge. This was evident in the second group that received feedback on their multiple choice questions and the final test.

9.1.2 Behavioural intentions

In the previous section, I discussed how participants acted, i.e. their behaviour for managing the e-learning course. These behaviours and actions were connected to intentions. Different approaches to both content and context were found based on interpretations of how participants' expressed their intentions.

Initial course approach: The initial course approach related to the participants' behaviour could be divided into either *preparatory* actions, or *trial-and-error* actions for managing the course. These were evident in how participants approached both the content and the context. I see these as two categories of what I call an initial course approach. From a process perspective on SRL the first preparatory phase (Puustinen & Pulkkinen, 2001) includes, for instance, forethought, planning, and activation (Greene & Azevedo, 2009; Pintrich, 2005; Zimmerman, 2005). The participants who had a trial-and-error approach towards content or context were, thus, less engaged in the preparatory phase. The trial-and-error approach was based on habits of acting derived from prior computer work habits, or from playing computer games.

Content selection approach: Why participants chose certain content derived from their motivation and the value they assigned the material. While exploring approaches to content further, I found that some participants selected content because of *interest derived from feelings of novelty*, while others selected content because of *pragmatic usefulness in their work*. This can be compared to earlier theories of intrinsic vs. extrinsic motivation (Deci & Ryan, 2000) or hedonic vs. pragmatic needs (Hassenzahl, 2010 on user experience). Participants were either intrinsically motivated by interest, or extrinsically motivated because of their work duties. These results are similar to the preparatory phase of SRL, which also includes how learners assign value through task analysis (Efklides, 2011; Greene & Azevedo, 2009; Zimmerman, 2005; Winne & Hadwin, 1998) and context analysis (Greene & Azevedo, 2009). Learners then set goals for themselves according to the assigned values (Boekaerts, 1996).

9.2   Cognitive regulation

Figure 16 further includes categories of cognitive strategies, which historically has been a strong focus in learning research (e.g., Peters, 2013). Cognition is not always connected

to visible actions. Therefore, interviews are important for illuminating subjective cognitive experiences and variations of cognitive strategies involving comprehension and the invisible, covert, part of the learning process. These are the cognitive actions for learning. The results derive from the third research target, which explores *which kinds of cognitive learning strategies participants use in their course work.* This part is related to the what-question; that is, the content and how learners use cognitive strategies in order to understand and learn.

9.2.1 Cognitive actions

Three main categories describe the cognitive actions of the participants: information organisation, comprehension, and comprehension monitoring. Furthermore, cognitive regulatory control is also part of the cognitive process, but strongly connected to both behaviour and affect (cf. Pintrich, 2005).

Information organisation: According to prior research (Tessmer & Jonassen, 1988; Weinstein, 2005; Weinstein & Meyer, 1991), information organisation is about structuring and restructuring information to fit into one's old knowledge base, finding key ideas, and categorising information. While exploring information organisation in the e-learning context, I found that it connects cognition to behaviour. It involves both *categorisation* and *sequencing* of content (the information to be learned) for various reasons, which influences choice of actions from a behavioural perspective. For instance, certain content is valued as more important, and chosen before or instead of other parts of the content. Some participants also chose content in a specific sequence in order to aid comprehension. This kind of action may also be connected to attention and effort regulation, in addition to comprehension monitoring. Hence, it functions as a support strategy for both cognitive and affective regulation.

Comprehension and integration of knowledge: To comprehend is to understand. The category of comprehension included four micro-level strategies, which can be separated with regard to how they were influenced by the learning design. *Knowledge patching* was aided by both feedback and multimodal sources of information. Through these affordances the participants had the possibility to search for pieces of information that would add to their knowledge and comprehension of the content. This could be either cumulative or assimilative learning as described by, for instance, Illeris (2007) and discussed earlier in section 4.3.1. Although, here, I do not distinguish between the kinds of learning that was achieved, but instead, looked at the strategic cognitive activity that was used. This is the difference between the targets of the how- and the what-question. In order to support the knowledge patching strategy, the learning environment should provide immediate feedback, which is preferably connected to sources of related information through hyperlinks. This was suggested by several participants, as well as shown in their self-directed manipulating of the environment whenever feedback was lacking, or in feedback-directed exploring. The latter was a more targeted patching strategy than the former because of the feedback. However, direct linking options

between feedback and related content would have made it more usable. *Comprehension through variation* was another strategy by which the participants described their focus on displayed variations of information in order to build comprehension. This did not need to be variations in terms of various sources of modality, but rather on the presenting of information from various perspectives of, for instance, right and wrong; old and new, etc. Hence, this strategy focused on comparing, in contrast to only adding on new information through knowledge patching (cf. Illeris, 2007, on accommodation). The comprehension strategies of *critical thinking* and *elaboration* were not found to be directly connected to the learning design as such. Instead, these were grounded in the participants' prior content knowledge and ability to elaborate on the information in relation to their own expertise on the subject. Here, they speculated on the content in various ways, comparing it to what they already knew. Hence, these were higher order thinking strategies where the objective was to integrate new knowledge with old understandings (cf. Piaget, 1977; Tessmer & Jonassen, 1988).

Comprehension monitoring: The category of comprehension monitoring involves various ways participants strategically monitored their understanding of the content. It is about how they took actions for checking their understanding and how they utilized affordances of the digital context in order to aid comprehension. By investigating how the participants discussed their comprehension monitoring strategies, we can see how learning designs can be specifically targeted to support the comprehension process. Examples of these also relate to all three phases of SRL (preparatory, performance, and appraisal), as can be seen in the following. *Cognitive preparation* is a comprehension monitoring strategy for proactive reflection on the content, involving metacognitive monitoring (Azevedo et al., 2013) and identification of prior knowledge in relation to the content. This micro-level strategy involves how participants monitored their thinking in order to increase learning, and how the digital context facilitated this strategic activity. The strategy of cognitive preparation is similar to what Pintrich (2005) referred to as metacognitive knowledge activation in the first phase of SRL, including forethoughts, planning and activation. However, I argue that, this strategy is a continuous process throughout the course work and part of a dynamic and iterative cycle of SRL. Cognitive preparation is, thus, an ongoing process of evaluating and monitoring how to relate to and understand the information. Thus, the educational design needs to support this monitoring need throughout the whole course. Whatever design features that cognitively prepare learners for content will give them an option of metacognitively reflecting on the content, their own relation to it (e.g., task value), and prior knowledge. Cognitive preparation can be supported by, for instance, clearly defining and describing course objectives, and also by using informative headings and a logical structure of the content. *Information clarification* as a comprehension monitoring strategy relates to what the participants did whenever there was a cognitive conflict or a problem related to comprehension. The action taken might be to repeat a passage until a satisfying level of understanding is reached. However, why the action is taken is different from repeating for the sake of memorisation as in the strategy of *practice an repetition*. It is also different from the earlier mentioned strategy of cognitive

preparation, as that is about forming a preparatory conceptual understanding of something before going deeper into the content. *Note taking* was discussed as a means for repeating and checking understanding. The use of practice questions was also a way of *self-testing* their memorisation and comprehension (cf. Zimmerman, 1989, on evaluations of progress). Finally, some participants had an awareness of the importance of *meaning negotiation and social feedback* for the purpose of comprehension monitoring, although the course subjected to study lacked such affordances. This kind of collective metacognitive awareness (Susimetsä, 2006) was derived from previous experiences of learning in the workplace and having to face problems without definite and clear-cut answers. One term used for describing affordances that allow for meaning negotiation and social feedback in e-learning is digital connectivism. I will discuss this further in chapter 10 on implications for corporate learning.

The difference between comprehension and comprehension monitoring is that the first is targeting micro-level strategies that build comprehension, while the latter includes strategies that monitor the level of comprehension; checking what one knows. However, the comprehension monitoring strategy of, for instance, note taking can also be used as a way to build comprehension, as well as a way to organise the content by selecting the most important information. Hence, these micro-level strategies are not easily separated. I have merely tried to define different characters of them in order to understand and illuminate their relation to the design.

Cognitive regulatory control: Participants' ability for cognitive regulatory control included their ability to maintain *effort*, direct *attention*, or to choose *modalities according to preferences*. For instance, participants regulated their cognition, and hence their comprehension, by identifying their preferences of utilizing multimodal presentations of content in order to be successful. Participants who discussed their cognitive self-regulatory strategies usually had a metacognitive awareness of their own needs and preferences for making their learning as successful as possible. Metacognitive self-regulation is described as a student's awareness, knowledge, and control of cognition; e.g., planning (goal-setting, and task analysis), monitoring (tracking one's attention, self-testing and questioning), and regulating (fine-tuning and adjustment of one's cognitive activities, checking and correcting behaviour) (Pintrich et al., 1991). From a design perspective, the modality preference regulation strategy showed the benefit of having both text and images as a source for a variety of perspectives of the content. However, the participants also reflected on instances when text and images did not support each other, which gave rise to negative emotions (see section 9.3.2 on triggers of emotions). This suggests that multimodal options provide learning flexibility, but not by default, only when designed to be aligned in highlighting content in a targeted manner. Regulation of attention was also found in relation to multimodal presentations of content. Some participants were aware of how they needed to shift their attention towards options that helped them understand. Thus, they kept their concentration on key information instead of letting themselves be distracted. Other participants had a motivational goal in how they used an attention regulation strategy. For instance, paying

attention to things that kept up their motivation. This indicates that cognitive regulation is closely connected to managing motivation, affect, and choice of actions (behaviour). It is part of the volitional control process, in which metacognitive feelings are utilized for monitoring cognitive processing as these feelings trigger decisions for controlling and regulating cognition (cf. (Deimann & Keller, 2006; Efklides & Volet, 2005). While attention regulation involved the direction attention was given in order to be successful, the regulation of effort involved the intensity of the attention on content. For instance, participants had to decide how many times to repeat content or how to be persistent in focusing on key information for the purpose of understanding (cf. Pintrich et al., 1991; Weinstein et al., 1987). As cognitive regulation is interconnected with affect and motivation, it will be discussed further in section 9.3.1 concerning intentions and affect.

9.2.2   Cognitive intentions

In the previous section, I listed how participants used cognitive strategies in order to understand the course material to their own desired level. These cognitive strategies did not happen by coincidence, but were applied in a certain intended manner (cf. Case & Marshall, 2004). Therefore, participants' intentions for applying cognitive strategies were also identified. This is describe as their cognitive learning approach; i.e. why participants applied cognitive strategies deriving from their intention-driven choices. Two approaches to applying cognitive strategies for learning were found. These became most evident in how participants discussed their strategies of approaching the practice questions and the final test.

Memorisation for achievement: Some participants chose to divert to a *memorisation for achievement* approach, focusing only on the results of the final test. They expressed how they diverted to this surface achievement approach, although it contrasted their own epistemic belief about learning (cf. Greene et al., 2010). Their intention was to memorise information in any possible way in order to get a passing score, although they knew that they would not learn the information properly by using this kind of strategy. Similarly, prior research studies on approaches to learning distinguish between deep and surface learning approaches (Marton et al., 1986), as well as an achievement approach, which can be either deep or surface (Biggs et al., 2001). Research has shown that factors that influence approaches to learning are, for instance, instructional design and form of assessment (Biggs et al., 2001; Richardson, 2000), as well as the situational context (Case & Marshall, 2004; Eklund-Myrskog, 1996). This study showed that participants adapted their approach to external circumstances and demands. The outcome of this is an adaptation of concrete strategies (behaviour, cognition, affect); i.e. the how of learning (Marton et al., 1993; Biggs, 1987; Richardson, 2000; Richardson, Morgan & Woodley, 1999). Similarly, the results of this study show that both the situational context of workplace learning and the assessment style influenced how participants approached learning, and this highlighted a close connection between their cognition and intention.

Comprehension for application: The second approach discussed by participants pertain to a deep learning approach and was named *comprehension for application*. Here, the intention was directed towards understanding the content and to be able to apply the new knowledge in real life. They were following their intrinsic drive towards deep learning. These two approaches to learning can be compared to prior research on deep versus surface learning (e.g., Marton et al., 1986), as well as the achievement approach (Biggs et al., 2001). We need to be acutely aware of how different types of assessment will guide users into applying certain cognitive learning approaches in accordance with the type of assessment we choose. I will elaborate on the impact of assessment style in Chapter 10.

9.3   Affective regulation

How participants experienced affect involved their being in relation to course content and the digital context. Both positive and negative emotions were generated by the human-computer interaction as a part of the essence of their user experience (cf. Hassenzahl, 2010). Their actions (doing) in relation to affect involve their ability for emotional and motivational self-regulation. Affective self-regulation is an important part of our learning process and has been found to be connected to how much learners like a course they take (Ben-Eliyahu & Linnenbrink-Garcia, 2013). Positive emotions of, for instance, interest and engagement have been found to enhance motivation and facilitate motivational self-regulation (Deci & Ryan, 2000). Hence, we can assume that user experience of an e-learning course may play a part in learner engagement and the learners' emotional self-regulatory abilities (cf. Azevedo & Aleven, 2013). The implications of the results pertaining to user experience and affect relate to how we can design for positive emotions and increased motivation. In the following, I will discuss participants' actions and intentions for affective regulation, as well as emotional triggers of the design.

9.3.1   Actions and intentions for affective regulation

Experienced emotions: The positive emotions participants expressed in relation to their course work during the interview were *excitement, feelings of freedom, interest,* and *activation*. The negative emotions expressed were *frustration, confusion, anxiety,* and *insecurity from decreased self-efficacy*. The emotions were triggered by different factors related to either the instructional design of the course content, the digital context, or the technological solution. These will be discussed further head.

Emotional and motivational regulation: Affect is an essential drive for our actions and cognitive processes. Our intentions for doing something are formed by a continuous affect regulation process (Damásio, 1994; Goleman, 1995; Oetley et al., 2011). Hence, the how and the why question in relation to affect regulation are intricately part of the same process. Participants' affect regulation involved how they regulated both emotions and their motivation. *Emotional regulation* was attempted by participants by taking

actions that made them feel safe or that increased their feelings of convenience. This was an approach intended to *avoid negative emotions* by staying on the safe side or taking only convenient options. Emotional regulation was, furthermore, attempted by choosing content and taking actions in order to increase positive emotions such as interest. This also included actions for *motivational regulation*; for instance, taking actions for the sole purpose of increasing motivation in order to be able to sustain effort to keep going. Hence, the results confirm prior research stating that affect regulation is an important part of volitional control (cf. Boekaerts & Cascallar, 2006; Deimann & Keller, 2006; Järvenoja & Järvelä, 2005; Kuhl, 1985). This second approach was intended to *move towards that which produced positive emotions*, such as things that interested or motivated them. In prior research, it is referred to as reappraisal, which is an emotional regulation strategy for diverting anxiety by focusing on something positive (Ben-Eliyahu & Linnenbrink-Garcia, 2013). An example of an action taken as a reappraisal strategy in the present study was one participant who systematically searched for motivational context affordances visualising his progress in the course work. He described that the intention behind the action was to increase motivation at a moment when he experienced negative emotions and was struggling to maintain effort. Hence, overview of progress as a contextual affordance can facilitate motivational regulation. It seemed as though a lack of personal investments and goals, lack of pragmatic task value, as well as usability issues made it more likely that the participants took actions based on safety or convenience in order to avoid negative emotions. For instance, some participants avoided accessing content that required a two-step action in order to gain access to the linked documents. This avoidance behaviour stemmed from triggers of negative emotions. However, the causalities of the factors that influence e-learners' affective approaches need to be studied further, as the aim of the present study was to explore it qualitatively from a design perspective.

9.3.2   Triggers of emotions and affective regulation

The fifth question targeted affect versus context. In the previous section, I have discussed how participants felt (the variety of emotions) and regulated affect (emotions and motivation). In this section, I will discuss affect from a design perspective and in detail list course features and dimensions of the experience that triggered positive and negative emotions (see Table 34). The concept of user experience in HCI refers to how the end-user subjectively experiences the digital context, and how it triggers and/or inhibits emotions. User experience of the course in this study refers to learners' subjective experiences while interacting with the self-paced e-learning solution. This subjective experience is also connected to motivation, as user experience is deeply rooted in fundamental needs as triggers of both actions and experiences (Hassenzahl, 2010). Hence, it is essential to understand *how contextual factors trigger and/or inhibit positive and negative emotions.*

There were many triggers of both positive and negative affect (see Table 32 and Table 33 in Chapter 8). In the table below, the triggers are only categorised according to two

categories: positive and negative triggers, in contrast to the previous tables, which listed each emotion separately. Instead, the triggers are categorised in accordance with four identified factors: *personal factors, instructional design of content, interface design of context*, and *technical solution*. In some of these categories it is obvious that the same trigger can be regarded as both negative and positive by different people. For instance, the situation of facing a new learning format (the e-learning course) was for some triggering negative emotion, while for others it was seen as a source of positive emotions.

Table 34 Triggers in relation to four categories

	Positive triggers	Negative triggers
Personal factors	Content related to own work New learning format Choose your own time, space, and pace A personal investment of some sort Receiving some kind of reward	Irrelevant content for own work Lack of prior content knowledge Confronting a new learning format Answering wrongly in practice questions
Instructional design of content	Clear objectives, examples, exercises Practice opportunities and challenges Stimulates you to think Stimulates you to move forward Real life visualization of content Images Animations Pictures, video Simulations Links Schemata, graphs, formulae	Time pressure in the final test Memorisation for final test Density of information to memorise Too much text Difficult vocabulary Indistinct headings Ambiguous content Disturbing animations Superfluous details in images Lack of feedback and assistance Lack of transparent content overview Ambiguous instructions
Interface design of context	Look-and-feel of the interface Colours Interactivity-based features Feedback on actions	Ambiguous navigational features Complicated interface Lack of navigational instructions Lack of transparent navigation structure Plain text in a white box Scroll-down feature No link between test feedback and content
Technical solution	Ease of use	Slow-functioning interface Computer problems Error message

Design for positive emotions

As can be seen in Table 34, emotional triggers were found on all levels: on a personal level, instructional content level, digital context level, or on a technical level. I will discuss these by emphasizing how design can facilitate positive emotions.

Excitement and curiosity: The participants in the course were curious about e-learning as a new format for learning. This excitement related to the novelty of the situation triggered by the new context, which was categorized as a personally derived emotion, although it also derived from the context. Curiosity was further discussed in relation to the content presenting a new perspective to what they already knew. This is similar to what Keller (2010) defined as inquiry arousal for catching learners' attention as a motivation strategy. Emphasising differences and variations in perspectives already in the overview of a course might trigger curiosity and feelings of excitement. When designing for novelty, curiosity, and excitement, the design aims to keep learners "positive and lively" (Douglas-Cowie et al., 2005). These positive emotions are furthermore involved in triggering intrinsic motivation for learning, which is related to both successful learning outcome and self-regulation (Deci & Ryan, 2000).

Autonomy and freedom: Feelings of confidence are important for motivational regulation. Learners' confidence is strengthened when their belief in their ability for success is supported sufficiently (Keller, 2010). Feelings of insecurity was found in relation to the use of complex vocabulary, which lowered the participant's self-efficacy beliefs. The data in the present study suggest that a transparent overview, navigational choices, and immediate feedback on actions will give users the opportunity to make up their own minds about which path to take in accordance with their own learning needs and interests. This will facilitate their self-directedness (cf. autonomy) towards their own goals and feelings of control. Thus, my suggestion is to design for autonomy and feelings of freedom by giving learners control over the learning situation. However, this has to go hand in hand with maintaining feelings of competence (Deci & Ryan, 2000) in managing both content and context, as well as the learning process. Important aspects related to this are flexible content and interface design, which enable learners to easily overview and manipulate these for their own learning needs, as well as scaffolding for problem management. However, maintaining the balance between learner control and instructional guidance is a difficult task (Holmes, 2007). One way of ensuring this balance is to conduct user studies during course development (e.g., Hassenzahl, 2010).

Interest and activation: In order to maintain interest and manage motivation despite adversity or boredom, the learner needs meta-affective awareness. This entails ability to reflect on the influence of emotions in learning. It was suggested that affordances for checking progress and comprehension throughout the course facilitated motivational regulation. Other suggestions to design for interest and activation are multimodal representations of content, clear objectives, examples relating the information to real-life situations, opportunities for practice, and a pleasing aesthetic interface. These

factors increase interest and activate the participants. However, above all, the content needs to be aligned with the needs of the target group and their current work situation. Not only is relevance of the content important for motivation (Keller, 2010), but adults are pragmatic in their approach towards learning (Brookfield 1996; Conlan et al. 2003; Knowles et al. 1998), which was evident among participants in the study.

Flexibility and individualisation: How participants made choices for learning was also influenced by how they managed their negative and positive emotions. Some moved away from that which made them experience doubt or negative feelings, for instance by rather choosing content that was familiar to them. Others faced difficulty in pursuing their learning path by targeting content that they were unfamiliar with. From a design perspective, this points to the importance of flexible content and a flexible interface, so that users can easily define their interests in relation to the content, plan their actions accordingly, and decide their path based on their individual needs and interests. Results suggest that multimodal options (e.g., text and images) provide flexibility regarding content. However, multimodal options need to be aligned in highlighting content in a targeted manner. Negative emotions was for some participants triggered by plain white text in a box. From a learning perspective, the added value of each course feature needs to be carefully considered. Research shows, for instance, for the purpose of learning, printed paper may be preferable to static text on a screen (Murphy & Holleran, 2004). We cannot ignore the fact that, today, most people are familiar with the possibilities computers provide regarding multimodal representations and flexible delivery of content. Not building on these affordances will influence the users' level of interest in the course.

Supporting both cognition and affect

Cognitive and affective load: How our limits of cognition and affect are influenced by the design of the context have been studied as cognitive load and affective load. Cognitive load refers to the limits of our working memory, and how this needs to be considered in the design of learning environments and instructional design (Kalyuga, 2011; Leahy et al., 2004). Affective load is described as uncertainty-factors in combination with experienced time pressure during the process of searching for information online (Nahl, 2004; 2005). The connection between cognitive load and affect is found from the list of negative triggers derived from the instructional design of content, such as need for memorisation of dense information, too much text, superfluous details, ambiguous content, etc. (cf. Kalyuga, 2011). These factors tend to cause negative emotions as they overload our limited short-term memory. Another type of cognitive load was the use of complex vocabulary, which generated insecurity and lowered self-efficacy. Learners' confidence and motivational regulation is strengthened when their belief in their ability for success is supported (Keller, 2010). An important aspect related to this is scaffolding problem management. Cognitive load may also be triggered by the interface design, as far as it builds on the load on our memory and perception (Kalyuga, 2011). As a contrast to this, positive triggers related to the interface

design had to do with the look-and-feel, for instance, colours, and also how the interface allowed for interactivity and feedback on actions. Positive triggers on this level were those that counteracted cognitive load by facilitating and supporting comprehension and content overview, and also those that stimulated thinking and real life connections. As far as the category of the technical solution is concerned, it can only be stated that it should work properly. Any kind of usability or accessibility issue will cause negative emotions. When considering these load factors in the context of learning, affect and cognition are aspects of the same experience, and therefore inseparable when considering their impact on the regulation of learning (cf. Goleman, 1995). Emotional experiences were found to be linked to a continuum of an affect-cognition dimension and impacted choices of actions (behaviour) for managing the learning technology context for the purpose of learning.

The affect-cognition continuum: As discussed above, the exploration of SRL areas highlight the close connection between participants' cognition and affect and how these areas form a continuum in the learning process. In the following, I use the model of Fleckenstein (1992, p. 449) illustrating the affect-cognition continuum for discussing cognitive load and affective load found in the results, and how this affected the participants' behaviour. The left side of Figure 18 represents the positive factors found in this study. These are sorted in accordance with the titles of the original figure by Fleckenstein (1992). Likewise, the right side of the figure represents negative factors found in the study.
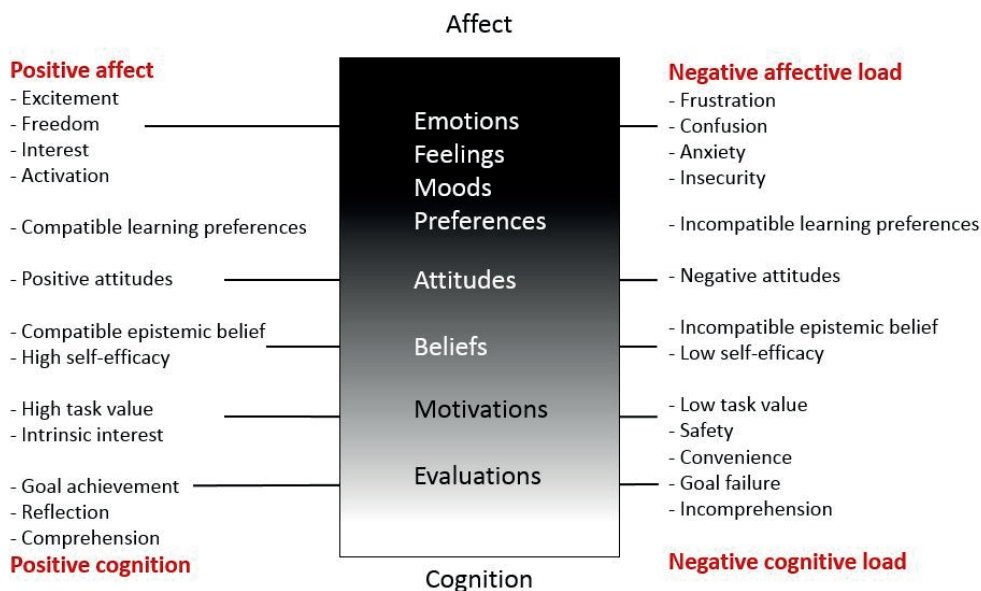

Figure 18 Affect-cognition continuum (adapted from Fleckenstein, 1992, p. 449).

Hence, the top right corner of the Figure 18 identifies negative emotions related to affective load. According to Nahl (2004), affective load is made up of emotional uncertainty plus felt time pressure (AL = U x TP). Similarly, the results of this study show that time pressure (cf. Table 34) is one aspect that causes affective load. However, there were other factors to consider regarding triggers of negative emotions in the e-learning experience, which can be seen as an expansion of Nahl's uncertainty-factors. Factors of emotional uncertainty in this study was represented by frustration, confusion, insecurity, and anxiety, while Nahl measured irritation, anxiety, frustration, and rage. Nahl argues that this compound factor of affective load is outweighed by positive self-efficacy beliefs and optimistic attitudes, which is also represented in the Fleckenstein (1992) model of the affective-cognitive continuum. One example of lowered self-efficacy beliefs, in the present study, was caused by complex use of language, which triggered feelings of insecurity and loss of self-efficacy. The choice of language used can be referred to as extraneous cognitive load, as it signifies how the content to be learned is represented (Leahy et al., 2004). Similarly, in Table 34, difficult vocabulary is listed as a negative trigger categorised at the level of instructional design of content.

Not surprisingly, research has shown that e-learning is most successful for those individuals who already possess self-regulatory abilities. For instance, Nahl (2012) found that learners who engaged in meta-affective reflection were able to re-prioritize feelings and emotions. Thus, negative affect could be reduced by a higher goal, and the learners persisted with the task. This shows the importance of reflection on both affective and cognitive reactions and judgments in relation to the learning task as well as the context. In the present study, I found examples of mature reflective thinking and self-regulative abilities in counteracting negative affective responses, for instance checking progress in order to raise motivation and maintain volitional control. Feedback facilitated reflection and regulation, for instance, cognitive regulation was facilitated by feedback, as it supported participants cognitively in identifying their gaps of knowledge. Feedback further supported them behaviourally in adapting to the environment and becoming self-directed in creating their own learning path. In relation to Figure 18 above, the left side needs to be strengthened and supported, while the right side needs to be counteracted and reversed. These are areas to target feedback and design features for supporting SRL.

10 Conclusions

In this concluding discussion, I will emphasize on the implications the results of the present study have for corporate learning. The orchestration of e-learning, its design and combination of digital tools for the purpose of teaching and learning, is, in many regards, still in its infancy. Although a few years have passed since the execution of this study, much remains to be explored in the field of learning technology design. Therefore, I will also discuss research questions to be explored further, as well as methodological considerations in relation to the research design.

10.1 Implications for corporate learning

In Chapter 9, I have discussed the results in accordance with the structure of the five specific research questions related to the areas of SRL. Here, I will draw conclusions how the results can be interpreted for designing corporate e-learning. This pertains to real life relevance of content, considerations about assessment style, and creating opportunities for connections between learners.

Real life relevance

Corporate learning needs to be pragmatic, as perceived by the corporate learners of this study. The value the content has for their work is a strong motivational factor, and a factor that will help them remember what they have just learned. As one of the participants quite bluntly said: *"[…] you can see it, read it, and understand it. But you don't remember it"* unless the content is of relevance to one's own work.

Illeris (2007) claims that motivational issues needs to be addressed by increasing positive factors of the environment, listening to the needs of the learners, focusing on the learners' real life situations and interests, make learning relevant to them, and give them autonomy in their learning. There is an increased understanding of motivational design for learning technology, as many researchers, for instance, focus on what motivational triggers are inherent in games that make people play and continue playing. These motivators are then applied to learning design. This is the concept of gamification, but it might also be referred to as motivational design. This stance is also at the core of experience design, in which the needs (cf. motivations) of the end-users are targeted as the guiding light for the design. The right question to ask, while designing for corporate learning, is then why would someone want, or need to learn this content? And then let the answer or answers form a base in designing the learning experience (cf. Moore, 2009). It is a balance between the added value for the corporation and the pragmatic and motivational value for the learner. Or perhaps it is more about synchronizing these two.

The impact of assessment style

The course under investigation had an assessment based on multiple choice questions. This type of assessment is recommended by some (Yost, 2002), while others advise against it (Reed & Francis, 2001; Sims-Knight & Upchurch, 2001). Even if a learner is intrinsically motivated to learn the content, this study showed that multiple choice questions may hinder learning. Based on the findings, it is clear that multiple choice questions may work for a small number of self-directed individuals. For some participants, however, the assessment style became a source of frustration, distorting their attention away from the significance of the content, towards focusing on the signs (e.g., Marton & Booth, 1997). They were triggered into manipulating the environment to achieve a passing score. This was by some done in a way that placed less importance on understanding the content, but instead, for instance, memorising visually which were the correct answers. At such instances, the learning achieved had nothing to do with the content. Hence, it does not even apply as cumulative learning (Illeris, 2007) of memorising facts for later recall. This kind of learning simply consisted of contextual manipulation strategies. I do not consider this a cognitive learning approach, as it is action taken for other reasons than for the purpose of learning the content.

I argue that when it comes to adult learners in a corporate setting, we need to consider the purpose of assessment carefully. How can we assess progress and learning without encouraging users to adapt to a *memorisation-for-achievement approach,* which is a cognitive learning approach for surface learning, and instead encourage them towards adopting a deep learning approach aiming for *understanding-for-application*? These were the two cognitive learning approaches discussed by the participants in the study. Based on the findings in the present study, there is no doubt that most of the pragmatically directed learners of the corporate world will not stick around to please a superfluous assessment system that does more to hinder learning by forcing them to focus on memorisation of details for the wrong reason (usually that the content had no purpose in their work at the moment). We need to ask ourselves what the real purpose of assessment is. Is the assessment a way to check who has completed the course; is it a way for users to check whether they understand the material; is it a way to practice and repeat the most important information, or all of the above and more?

This study points to the challenge of using multiple choice questions as an assessment style. Preferably, multiple choice questions can be used in a course as long as it is for the purpose of practice and repetition, and the variations of the alternatives of the choices are easily discernible, written in a simple language, and as short and specific as possible. However, it might be preferable to make it non-compulsory. The results also shows that we need to step away from thinking that learning is about being tested by authority (cf. Kress & Selander, 2012 on power), and instead dare to hand over control to the learners, trusting them to be able to judge what is important for their work, and assess their level of knowledge in support of the community. This might sound rather naïve, and I am certain that such a system will be misused by some. However, I see that as less of a

sacrifice than demotivating learners who have a deep approach towards learning, which was the case in this study, because of the assessment style. The rigidity of the multiple choice questions frustrated participants by taking away their autonomy (cf. Deci & Ryan, 2000) and control in choosing to learn what was important for their own work, and instead forcing them to memorise details disregarding the usefulness and applicability of the content in real life. With regard to assessment, I argue that focus needs to be placed on the relevance the content has to the learner. Make the assessment about the process of learning, instead of memorisation of details. Use social networks for discussions about topics of importance. Require engagement and interaction with others, and let the learners themselves build a knowledge community through their interactions.

Connectivism and social meaning negotiation

As Siemens (2005) claims in his theory of connectivism, knowledge today is an ever-changing currency, and we thrive best when we rather focus on knowing about from whom and where to obtain the latest updated knowledge than memorising everything ourselves. I suggest designs should facilitate learners building relationships around important topics related to their work, and thus, generate new knowledge that takes the corporation forward in development, instead of the workers individually repeating old conceptions and understandings. As a few of the participants claimed, there are seldom any straightforward answers to problems, and solutions are best found from social negotiations based on differing opinions and variations of optional solutions. Kress and Selander (2012, p. 267) point out that "social action as interaction is the generative basis of meaning: an ongoing, ceaseless chain of rhetorically motivated selection, (re-) designed transformation/interpretation". Therefore, we need to design for assisting and facilitating deep reflection, both individually in relation to own work, as well as connectively in negotiation with others about their conceptions and reflections on the content. The design targets then becomes a matter of integrating learning solutions as parts of a bigger process involving the individual in connection to the collective; a socio-cultural perspective on corporate connectivism for learning; a dynamic ecology of corporate learning. Thus, knowledge is something larger than an individual process. Based on this conception, corporate learning extends beyond judging peoples' levels of knowledge towards motivating the development of knowledge structures and negotiations of conceptions within the corporation. Hence, the line between corporate learning and corporate knowledge management becomes blurred in the digital landscape. How we design learning solutions is one important key for turning this into a win-win solution. The philosophy and ideology inherent in and transmitted by learning technology, is shaping how we function individually and as a group. It affects how the processes of learning are allowed to develop and the character it will take (Siemens, 2010). From an organisational perspective, this means that the way learning is designed will affect what the organisation will become. This is a critical question, as academics highlight the fact that how fast employees are learning in an organisation will determine its success (Garvin, Edmondson, & Gino, 2008).

Feedback, flexibility, functionality, fun, and freedom

Regarding self-paced solutions for corporate e-learning, the results suggest that feedback is the best way to facilitate self-regulation. In addition to feedback, targeting multiple levels of the affective-cognitive continuum, the results further show that designers of corporate e-learning should design for flexibility, functionality (both regarding content and context), as well as fun and freedom. Self-regulation needs to be facilitated for managing both the content and the e-learning context. These two levels of the e-learning course require different learning processes, and hence, need to be seen as separate properties to be managed.

10.2 Are we designing new learning experiences?

The question remains: are we designing new learning experiences? I believe we are – especially in considering how the design needs to scaffold design-based epistemic metareflection in new and innovative ways, as the learning technology design must compensate for the lack of traditional feedback systems inherent in face-to-face interactions for learning. I will explain what I mean by this concept in the following. In Figure 19, I illustrate three dimensions related to the design of new learning experiences.

Learning experience dimension

Affect and cognition are intricately interwoven in a learning experience (cf. Efklides, 2011; Fleckenstein, 1992; Kalyuga, 2011), and therefore inseparable when considering their impact on the regulation of learning (cf. Damásio, 1994; Goleman, 1995). Furthermore, both positive and negative experiences deriving from the design will have an impact on the learning experience. This is the result of "being" in the design (cf. Hassenzahl 2010 on user experience). Hence, the learning experience is a combination of both the continuum of cognition and affect, as well as a spectrum of both positive and negative experiences related to this continuum. This is illustrated in the learning experience dimension of Figure 19.

SRL agency dimension

The results imply that in order to empower corporate e-learners for self-paced e-learning, we need to consider how to support both their metacognitive and meta-affective abilities. These include awareness and control of their thought processes for the purpose of learning, as well as awareness and control of their emotions that are influencing their learning activities and motivation. The awareness of one's affect-cognition continuum represent learners' ability for metareflection. In addition to this, an epistemic metareflection represents learners' reflections on their own reflective abilities in relation to how they create knowledge. This epistemic metareflection, thus includes both metacognitive and meta-affective abilities (cf. Azevedo & Aleven, 2013; Ben-Eliyahu & Linnenbrink-Garcia, 2013). Epistemic metareflection can become

design-based when learners are aware of how they can regulate their cognition and affect in relation to a specific learning context. This sets the frame for their learning actions and behaviour (see SRL agency dimension of Figure 19) and builds their agency for SRL in relation to both content and context. *Design-based epistemic metareflection* implies a deep and broad reflection that is grounded in the affordances and constraints of the learning technology design; how learners are able to develop their awareness of and strategies for utilizing a particular design in the best way for successful learning. This represents the SRL agency dimension in Figure 19. The ability for design-based epistemic metareflection is at the core of digital literacy and influences learning behaviour.
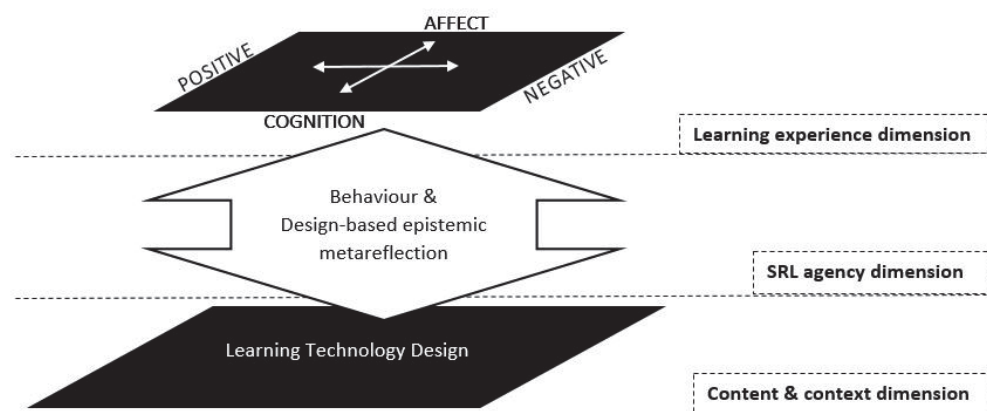
Figure 19 Dimensions to consider in designing for SRL.

To the extent that the design can support learners in developing this design-based epistemic metareflective ability, the learners will be scaffolded in becoming SRL experts, self-directed manipulators, and strategic explorers. Design-based epistemic metareflection can be supported by targeting all three areas of SRL: cognition, affect, and behaviour. The learning designs can support learners' regulation of affect (e.g., how to reflect on and monitor their emotions and motivation), their regulation of cognition (e.g., providing modality options, guiding attention properly, and facilitating effort), and behavioural regulation (e.g., assisted by a logical context navigation and instructional design of content that brings about positive emotions).

Content and context dimension

Learning technology design is about creating a learning experience in which the design of both context and instructional content are to be viewed as interconnected and inseparable parts. However, the management of the two dimensions of context and content still represents different processes related to e-learning. Dix et al. (1997) discuss learnability, which represents how easy it is to learn to use the digital context. The content-perspective is targeted by Nokelainen (2006), who defined pedagogical usability

to measure how content comprehension is facilitated by the context. Furthermore, I address the SRL agency dimension as another key design factor to consider, especially the facilitation of developing design-based epistemic metareflection. This design factor pertains to both content and context, but is also framing the importance of the learning experience dimension.

10.3 Future research

This study has approached SRL from an exploratory perspective using qualitative data mainly. Hence, there can be no generalisation of causality between the factors related to self-regulation of corporate e-learners. The study revealed the necessity of further research examining micro-level processes of SRL more specifically in relation to differences in learning contexts. I argue that this is a never-ending research problem to address in each new learning design project. Although the macro-level processes can be generalized between contexts, micro-level processes may differ (cf. Greene & Azevedo, 2009), and therefore, should always be thoughtfully scrutinized for each new context, target group, and learning design. Another research perspective to be pursued is to focus on learners' regulatory patterns and trajectories over time (cf. Winne & Perry, 2005), including co-regulatory dimensions (cf. Järvenoja, 2010).

Based on the present research, I argue that one key to good e-learning design is to cater for contextually derived needs related to both metacognitive and meta-affective reflection of learners (cf. Azevedo & Aleven, 2013; Ben-Eliyahu & Linnenbrink-Garcia, 2013). By supporting this SRL agency, for instance through feedback on actions, learners will be better equipped to regulate and develop cognitive and affective abilities required for managing the digital context. Hence, it will support them in becoming expert learners through the facilitated reflection on their own learning process. This perspective needs to be included in the concept of pedagogical usability (cf. Nokelainen, 2006). Therefore, future research should focus on the total learning experience and its dynamics of cognition and affect in relation to the learning context design, as well as the instructional design of the content – not only for learning the content, but for how it supports the development of design-based epistemic meta-reflective abilities of digital learners.

The consistent question is how learning designs can most effectively and efficiently respond to self-paced e-learners' regulatory needs. For this question to be answered, I see a need for interdisciplinary cooperation and collaboration in the design of learning technology solutions and the research on their impact for learning. All dimensions of the TPACK-model (Koehler & Mishra, 2008) need to be accounted for in both research and development of learning designs. For this purpose, another area to pay attention to is the development of a variety of methods for measuring pedagogical usability and learning experiences in relation to various contexts. These methods need to be able to capture both the process and the product of learning, as well as be contextually

independent. This is important for establishing the potential added value for learning a solution might offer. This is where my research continues.

10.4 Methodological Considerations

The purpose of this study was to not be able to generalize results. The purpose was to qualitatively explore and describe the behaviour, cognition, and affect of corporate e-learners' self-regulated learning in relation to the two iterations of the course. The design perspective therefore influenced the choice of methods of the study. I will discuss a few considerations in the following. In a sense, these considerations describe the learning process that I have had as a researcher throughout my own journey.

How did the selected measures measure up?

I began my research process by searching for a SRL questionnaire adapted for e-learning. When I could not find one in the early 2000s, I decided to make one. I made a couple of questionnaires adapted for different e-learning contexts. However, the response rate for the replies was too low in both cases, and I had no control over the population in order to be able to raise it. This gave me insight into the problems of using questionnaires for the purpose of measuring SRL for e-learning – both from the perspective of the quality of data and the collection process. The most obvious fact was that it did not provide the depth of understanding that I saw the need for in the learning design projects I was involved in during this time (cf. Reigeluth & Frick, 1999, on the need for formative research). This is also in line with the critique against measuring SRL as an aptitude (Azevedo & Aleven, 2013; Winne & Perry, 2005). I chose to use questionnaires targeting self-regulated learning anyway as comparative data in a multi-method approach. However, I designed the RESQUE questionnaire in such a way that it would serve as a tool for reflection for the participants after their learning session was completed. This was done by keeping thematic items in clusters and adding informative headings for each cluster (see Appendix 2). It also facilitated their evaluation of the digital context in terms of how it supported their learning. However, these results were used qualitatively in the analysis.

A multi-method approach for a mixed research design was chosen in order to achieve deeper insights and broader perspectives on the targeted research area, and for feeding back to the designer during the iterative design process. The selected research design included methods that, according to Winne and Perry (2005, p. 563-4), allowed for an exploration of "unfolding patterns of engagement with tasks in terms of the tactics and strategies that constitute SRL". The backbone of these methods was screen recordings (including eye tracking) and stimulated recall interviews. Strength from these methods was gained by both methodological triangulating during data collection, and by data triangulation during analysis. However, the ambition was to go even further in integrating quantitative data (questionnaires) with qualitative data (observations and interviews). This is what Winne and Perry (2005, p. 563-4) identify as triangulating methods for measuring SRL as an aptitude with those measuring it as an event in order

to illuminate the "full spectrum of SRL". Unfortunately, this was not possible in the present study, but it is indeed an ambition for future studies.

Eye tracking changes everything: There was a difference between the interview situations of the two groups because of the introduction of the eye tracker in the laboratory. When the first group of participants watched the screen recording, they saw the same thing they just experienced while interacting with the content. Hence, there were no surprises. However, when the gaze paths of the eye tracker was added as a new layer on top of the interactivities visible on the screen, the situation changed dramatically for both the interviewer and the interviewee. Watching the red agile dot tracing eye movements across the screen for the first time caused mesmerized reactions by the participants. This was a new phenomenon to discuss and take into consideration during the stimulated recall interviews. Because of this, I had to do more pause and rewind during the first few minutes, so that the interviewee would become acquainted with the action data on the screen. Despite this slight drawback, the eye tracking data were invaluable for both the observational analysis and the stimulated recall interview. It provided opportunities to become closer to the dynamics of the learner activities and, hence, also be able to focus on more specific details of the learning experience in relation to the design.

Research biases: When doing research on peoples' behaviour of any kind, there will always be factors to consider that might have biased the findings. In the present case there are several potential biases; for instance, the impact of the laboratory environment, lack of motivation for learning the content, as well as apprehension of the new e-learning format of the course. I will briefly discuss these in the following.

Being in a laboratory environment will most certainly affect a person to some degree. However, in this case the laboratory was designed in such a way that it resembles a normal home in order to reduce a laboratory atmosphere. The participants' overall mobility was compromised because they had to have one hand totally still and strapped to the cords for monitoring their psycho-physiological reactions. Another factor that might have made them uncomfortable was the fact that the whole session was being recorded by audio (interview), video (surveillance camera), and screen (eye tracking). Most of the test persons had never taken an e-learning course before. Therefore, they might have been somewhat apprehensive while not knowing what to expect. The fact that there was a test in the course was another factor that evoked apprehensive emotions. The participants' knew that they had to learn and show their performance in the final test. Maybe the most significant consideration was the fact that the course content was not equally connected to all the participants' work. Neither was it a compulsory course for any of the participants. These factors might have influenced their motivation and levels of engagement for learning the content (cf. Knowles et al., 1998).

Analysis

The load of new and multiple methods: It was a demanding task to sift through all the multiple types of data and make hard choices of what to include or exclude. I was one of the first to collect data in the laboratory of MediaCity, and was in effect a guinea pig myself. The analysis has been carried out in sequences of data preparation and data transformation of the various types of data collected. Then the multiple data types have been analysed separately, as well as correlated and compared in a mixed analysis. Not only has the analysis of the data been inductive to a large extent, but I would also like to define the approach towards the use of methods as inductive in itself. However, the steps have been guided by the logic of the types of data providing differing perspectives on SRL, as well as the perspectives of the division of SRL into areas.

The importance of being part of a community of practice: Thomson and Kamler (2013, p. 6) argue that "the most enjoyable but also productive institutions are those where writing is a collective practice". Although I have presented my work and analysis at numerous seminars and conferences in order to obtain feedback and verify my findings, I cannot deny that I remain critical of being alone in the process of analysis. Being a part of a community of practice that confirms ideas and gives feedback is essential for smooth and productive research and writing process (Thomson & Kamler, 2013). When I started this research project, I also changed academic discipline and faculty, but without becoming involved in any new community of practice because I lived abroad at that time. It has been disruptive and lonely from an academic perspective – to say the least – to repeatedly move between four continents during this research process. The two year period when I had the opportunity to be close to other educational researchers in "the research tower" of Tritonia in Vasa confirmed the importance of daily contact with colleagues. The discussions during coffee breaks proved to be just as confirmative and motivationally inspiring as seminars and conferences – sometimes even more. This is also interesting from the perspective of my research area of self-paced e-learning. There is no doubt in my mind that the learning process is facilitated by face-to-face discussions of topics to be learned (cf. Zariski & Styles, 2000). There is, furthermore, much confidence to be gained from being part of a community of practice, in which one can indulge in social negotiation and meaning making in order to create one's identity as a researcher (cf. Thomson & Kamler, 2013, on identity). This has been my struggle.

The educational design research perspective

This study is framed as educational design research. The first research question targeting the difference between how the participants managed the e-learning course falls within this frame. The rest of the questions are diving deeper into the participants' micro-level processes of self-regulated learning based on an exploration of their subjective learning experiences. In these parts of the analysis, I do not distinguish between the processes of the two groups – only referring to them as examples. Although only the first question pertains to a typical educational design research setup and analysis, I still choose to

frame the whole study as such. This is due to the whole design of the study being grounded in the course development and exploration of e-learners' self-regulation. Hence, not all questions pertain to an explicit focus on a comparison between the effects of the two iterations, but rather focus on variations of SRL in more general terms. I chose this perspective, as I felt that the iterations did not provide enough difference in instructional design, apart from the addition of the feedback. The feedback is only one affordance provided by the e-learning context. The participants' SRL stems from many more factors than feedback alone. The general aim of this study was to see how the design of one specific e-learning course influences corporate e-learners' self-regulated learning actions and intentions. Based on the results, further research on learning designs for corporate e-learners can more specifically target micro-level processes of SRL.

Svensk sammanfattning

Inledning

Den svenska titeln på avhandlingen är *Design av nya lärupplevelser? En undersökning av självreglerat digitalt lärande i företag.* Frågetecknet i titeln hänvisar till svårigheten att på förhand veta hur ny teknologi kommer att påverka oss och skapa nya upplevelser. Medieforskaren McLuhan (1964) menade att vi kör in i framtiden med endast backspegeln som vår guide; med andra ord, vi tolkar vår verklighet utgående från det som har varit och kan endast retrospektivt förstå hur det nya har påverkat oss och våra liv. Vi kan således inte förutse hur vi och vårt samhälle kommer att påverkas av ny lärteknologi. Pedagogisk designforskning (educational design research) försöker angripa den här problematiken utgående från ett design- och utvecklingsperspektiv. Det är en praktiskt inriktad forskningsansats som fokuserar på skillnader i effekter av olika iterationer av samma pedagogiska design. Genom att lyfta fram designens inverkan på vårt lärande och vår lärupplevelse kommer vi närmare en förståelse av hur nya former av lärteknologiska lösningar kan användas och formas på bästa sätt. I enlighet med McLuhans metafor är pedagogisk designforskning således ett sätt att försöka flytta blicken från backspegeln till körriktningen. Avhandlingen tar avstamp i en dylik pedagogisk designforskningsansats, i vilket den tudelade ambitionen är både en konkret utveckling av kursen design och en djupare förståelse av designens inverkan på självreglerat lärande (härefter förkortat SRL). I den empiriska studien granskas hur personal i ett större industriföretag hanterar en digital kurs för självständigt lärande; kursen är ämnad att tas på egen hand i egen takt. Fokus i studien ligger på deltagarnas SRL och hur kursens design påverkar och stöder lärprocessen samt hur de lär sig att hantera lärmiljön.

Min drivkraft att skriva den här avhandlingen kan diskuteras utgående från fyra motiv. Det första motivet är förankrat i ett snabbt förändrande samhälle, där vi alla berörs av den teknologiska våg som genomsyrar hela vår existens. Ny teknik har möjliggjort en exploderande marknad av digitala lösningar för e-lärande, där vuxna i arbetslivet ofta förutsätts lära sig hantera nya lärmiljöer och ta till sig lärostoff på egen hand. Marknadsföring om att vi kan lära när som helst, hur som helst och var som helst fokuserar på möjligheter som de nya lärteknologiska lösningarna ger, medan den lärandes psykologiska perspektiv ligger i skymundan. Forskning har till exempel visat att lärostoff som lika bra kan läsas på ett papper, inte skapar några bättre förutsättningar för lärande bara för att det läses på en skärm (Murphy & Holleran, 2004). Det kan tvärtom ha negativa konsekvenser för lärprocessen. Fortsatt forskning behövs för att bättre förstå den kontinuerliga förändringen av kontextuella förutsättningar som påverkar vårt lärande (Davis & Wong, 2007; Azevedo & Aleven, 2013), dvs. ett pedagogisk-psykologiskt perspektiv på den lärande i förhållande till utformningen av lärteknologiska lösningar. De flesta studier inom området SRL riktar in sig på elever i grundskolan eller på universitetsnivå. Vuxna anses vara självreglerande och pragmatiska i sitt lärande (Brookefield, 1995; Knowles et al., 1998), men studier kring SRL i en

industriell kontext är få och speciellt vad gäller forskning av SRL i digitala lärkontexter. Forskning kring lärteknologiska lösningars mervärde för lärande är viktig, och ett designperspektiv möjliggör en förståelse av vilka faktorer som hjälper eller stjälper den lärande att hantera lärsituationen som helhet.

Det andra motivet utgår från vikten av att lyfta fram behovet av pedagogisk teknologisk expertis i utvecklingen av digital lärteknologi (Koehler & Mishra, 2008; Peters, 2013). Det finns en betydande fördröjningseffekt på grund av att den digitala utvecklingen är snabbare än vi hinner forska och etablera kunskap kring de mänskliga behoven i relation till tekniken. Det är samma problematik som McLuhan (1964) syftade på när han påstod att vi endast retroaktivt kan förstå hur tekniken förändrar oss och vårt samhälle. Sett ur ett designperspektiv är det viktigt att vara medveten om att hur vi designar tekniska lösningar har en stark koppling till både filosofi och ideologi (Siemens, 2010). Vi bör först fråga oss vad vi vill åstadkomma med en pedagogisk design. Här kan pedagogisk designforskning (som påminner om en användarcentrerad designprocess) bidra till att identifiera behov hos slutanvändarna, som gör att målet med den tekniska lösningen lättare kan uppnås.

Det tredje motivet berör forskningsmetoder och metodologiska frågeställningar i förhållande till designforskning. I min roll som forskare och forskningskoordinator vid MediaCity, har studien fungerat som en metodologisk upptäcktsresa i möjligheter att empiriskt studera självreglering och lärupplevelser i digitala lärmiljöer, men även att ur ett bredare perspektiv se på användbarhet och användarupplevelser i en användarcentrerad designprocess. Det fjärde och sista motivet, som har lett mig till att fördjupa mig i forskning kring lärande i digitala kontexter, grundar sig i ett personligt intresse för teknik. Medan jag bodde i Indien under några år kring millennieskiftet upptäckte jag för min egen del vilka möjligheter Internet och datorer kunde ge. Därefter gick jag en tvåårig distansutbildning i IT-pedagogik vid Kalmar universitet i Sverige för att lära mig mer om dessa möjligheter. På så vis fick jag kunskap om, men även egna erfarenhet av, att själv ha studerat med hjälp av olika lärteknologiska lösningar, vilket gav mig insikter i vad självreglering i digitala lärmiljöer kan innebära. Jag har även fungerat som pedagogisk konsult för utvecklare av digitala lärkontexter och även som forskare av digital design och användarupplevelser i mitt arbete på MediaCity.

Självreglerat lärande

Självreglerat lärande (SRL) definieras som lärandes förmåga att påverka den egna lärprocessen på olika sätt (jfr Azevedo & Aleven, 2013) genom att kontinuerligt övervaka och kontrollera tankar, känslor och handlingar i relation till kontexten och dess läromål (e.g., Azevedo et al., 2013; Pintrich, 2005; Zimmerman, 1989, 2005). De här faktorerna kan kategoriseras i områden (Pintrich, 2005). Att dela upp SRL i områden baseras på föreställningen att vi kan se på vårt lärande utgående från det vi gör (beteende och aktiviteter), hur vi tänker om det vi gör (kognition) och hur vi känner i relation till det vi gör (affekt och motivation). Ett annat perspektiv på SRL är att se på det som en cyklisk

process (t.ex. Zimmerman, 2005). Den cykliska processen kan delas in i tre generella faser: *förberedelsefasen, prestationsfasen* och *utvärderingsfasen* (Puustinen & Pulkkinen, 2001). Dessa tre faser är en sammanfattande kategorisering av hur de dynamiska och cykliska faserna beskrivs i olika SRL modeller. Till exempel Pintrich (2005) beskriver förberedelsefasen som förutseende, planering och aktivering. Prestationsfasen delar han in i två olika kategorier: övervakning av lärprocessen samt kontroll av den. Den sista utvärderingsfasen utgörs av hur den lärande reagera och reflekterar över lärsituation och dess innehåll. Det verkar inte vara någon skillnad mellan hur forskare kategoriserar SRL-processfaserna i traditionella lärkontexter jämfört med digitala lärkontexter. Men det bör noteras att de generella faserna är kategorier av lärprocessen på en makronivå (Azevedo et al., 2004), vilket inte nödvändigtvis påverkas av kontexten. Det är så kallade SRL-processer på mikronivå som påverkas av lärkontextens utbud och möjligheter, men också dess begränsningar. Genom att beakta essensen i dessa mikronivåprocesser kan vi identifiera de viktigaste aspekterna för SRL i relation till designen av den digitala lärkontexten. Mikronivåprocesserna är således nycklar till en djupare förståelse för hur vi designar digitala lärkontexter som målinriktat stöder de lärandes självreglering.

Det är viktig för utvecklare av lärteknologiska lösningar att förstå olika dimensioner av regleringsprocessen för att kunna designa för den på bästa sätt (Azevedo & Aleven, 2013; LeFrere, 2005; Peters, 2013) eftersom lärkontexten har visat sig ha stor betydelse för hur lärande klarar av och väljer att hantera lärsituationen och reglera sitt lärande. Därtill har även sättet på vilket bedömning av lärandet sker visat sig påverka lärandes ansats (e.g., Richardson, 2000). Men även något så enkelt som utseendemässiga faktorer påverkar hur användare klarar av att hantera en digital miljö (Norman, 2003; Peters, 2013). Därmed anses utformningen av kontexten vara en betydande faktor för hur lärande kan hantera och reglera en framgångsrik lärprocess (Pintrich, 2005). I figuren nedan illustreras de tre SRL områdena kognition, affekt och beteende som kugghjul som interagerar dynamiskt i relation till de kontextuella förutsättningarna. Dessa stödfaktorer är aspekter av interface designen (t.ex. utseende), det tekniska systemet (t.ex. tillgänglighet för lärande med olika behov), samt pedagogisk design av lärostoffet (t.ex. multimodalt innehåll och övningar). En exakt gränsdragning mellan dessa tre nivåer är inte alltid enkel. Därmed har figuren inte heller någon avgränsning i fältet för kontextuella stödfaktorer.

Vi kan anta att de lärande är tvungna att anpassa sitt sätt att hantera lärandet i digitala lärkontexter (Tsai, 2009) eftersom självregleringen i lärprocessen till stora delar är kontextspecifik och medför att vi anpassar våra strategier på en mikronivå. Därmed kan det vara oändamålsenligt att utgå från lärandes behov i traditionella kontexter när vi ska designa för digitalt lärande (Azevedo & Aleven, 2013; Lee, 2004). Ett nödvändigt pedagogiskt mål med alla former av lärteknologiska lösningar är att designen ska vara formad för att stöda självregleringen för ett optimalt lärande. Lärkontexter har därmed två pedagogiska mål; att lära oss ett innehåll samt att lära oss reflektera över vår lärprocess i förhållande till en digital kontext så att vi blir bättre på att hantera och

reglera den (Azevedo & Aleven, 2013). Genom att se på SRL-processer på mikronivå kan vi fånga upp huruvida dessa mål möjliggörs av en lärteknologisk kontext.
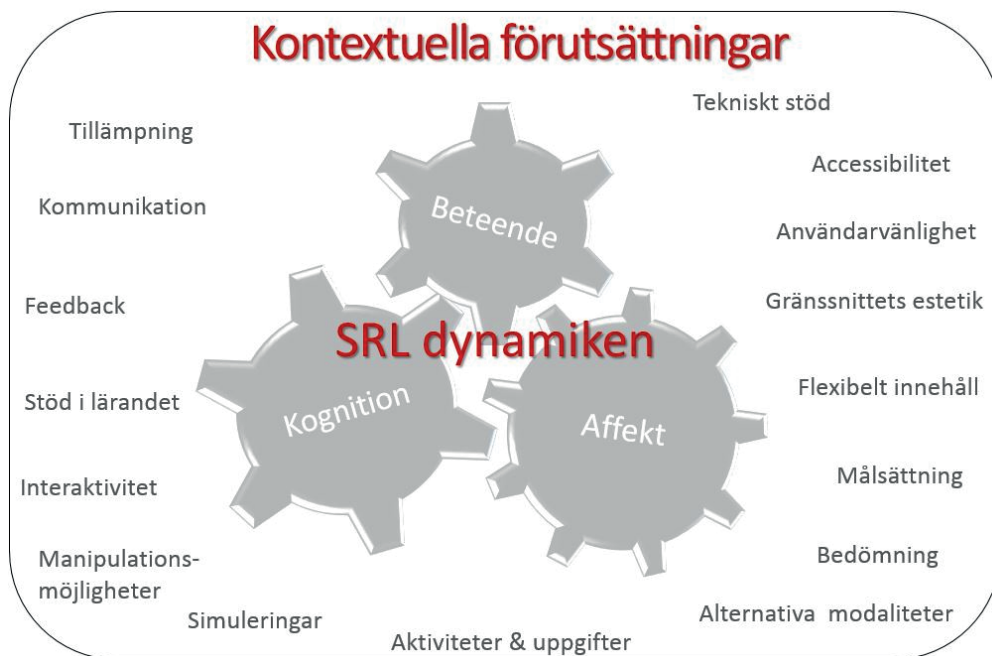
Figur 1 Exempel på kontextuella faktorer och SRL-dynamiken.

Frågeställning, ansats och metod

Frågeställning: Den övergripande frågeställningen i den här studien försöker ringa in SRL i förhållande till designen. Frågan lyder: *hur påverkar den digitala kursen deltagarnas handlingar och intentioner*? Handlingar motsvarar hur deltagarna gör, medan intentioner motsvarar varför deltagarna väljer olika handlingar. Kursdesignen utgörs av två nivåer: kursinnehållet, som motsvarar vad deltagarna ska lära sig, och den digitala kontexten, som motsvarar var det sker. Dessa fyra ateoretiska frågor (hur, varför, vad och var) är spelrummet för självregleringen i lärsituationen (Zimmerman, 1994). För att få ett brett perspektiv på de möjligheter den pedagogiska designen av kontexten ger för självreglerat lärande, tar jag även fasta på områden av SRL såsom beteende, kognition och affekt (Pintrich, 2005). Detta möjliggör en granskning på mikronivå i motsats till att se på processfaser (makronivå av SRL) enligt tidigare SRL-modeller. Tabellen nedan ramar in de ovan beskrivna delar av SRL som forskningen ämnar belysa och granska. Delarna är förankrade i tidigare SRL-teorier och modeller och ringar in områden och dimensioner av vikt. Idén är inte att separera dessa på ett konstgjort sätt, eftersom dessa mer eller mindre konstant interagerar i den dynamiska

lärprocessen. Målet med tabellen är att beskriva ramen för granskningen av SRL, utan att behöva binda mig till någon förhandsbestämd modell eller teori.

Tabell 1 Ram för frågeställning

Ateoretiska Frågor		Hur? (Handling)		Varför? (Intention)	
	SRL / Kurs	Synlig SRL	Osynlig SRL		
		Beteende	Kognition	Affekt & Motivation	
Vad? (Innehåll) Var? (Kontext)	Iteration 1				
	Iteration 2				

Studien är en granskning av SRL på mikronivå av deltagarnas handlande (hur?) och intentioner (varför?) samt hur dessa påverkas av designen av innehållet (vad?) och den digitala kontexten (var?). När hur- och varför-frågorna riktas mot beteende, kognition och affekt blir frågorna jag har försökt besvara följande:

- Hur gör deltagarna?
- Varför väljer deltagarna att göra som de gör?
- Hur tänker deltagarna?
- Varför väljer deltagarna att tänka som de gör?
- Hur känner sig deltagarna?
- Varför känner deltagarna som de gör?

Designen av den digitala kursen representeras av ett komplext interface med många egenskaper och funktioner. Jag ser på helheten av designen och förutsättningar i den som påverkar deltagarnas SRL. Därtill fokuserar jag på de faktorer som förändrades mellan iteration 1 och iteration 2 i kursutvecklingen ur ett pedagogisk designforskningsperspektiv.

Pedagogisk designforskning: Forskningsansatsen grundar sig i pedagogisk designforskning. Det innebär att det finns en dubbelsidig ambition med studien: ett teoretiskt bidrag och ett praktiskt bidrag i form av konkret utveckling av den pedagogiska designen (jfr McKenney & Reeves, 2012). Iterationer av kursen utvecklas i faser utgående från testresultat av slutanvändarnas reaktioner, reflektioner och hantering av lärmiljön. På så sätt genomgår den pedagogiska designen en design-baserad utvecklingsprocess, där kursen testas i verkligheten för att fånga upp hur den kan förbättras.

Pedagogisk designforskning består av tre faser, vilka medför en flexibel och iterativ struktur för forskningsupplägget (McKenney & Reeves, 2012). I den första fasen (undersökning/analys) utfördes först en pilotstudie och sedan testades den första kursiterationen på tio deltagare. I analysen av data från dessa deltagares lärupplevelser identifierades problemområden och konkreta åtgärder som kunde vidtas för att förbättra designen. I den andra fasen (design/prototyputveckling) gavs feedback till

kursutvecklarna på basis av analysen och problemidentifieringen. En ny iteration av kursen togs fram. Den tredje fasen (evaluering/tillbakablickande) bestod av att testa den andra iterationen på 8 nya deltagare (varav 7 togs med i den slutliga analysen). Slutligen gavs en summering av lärupplevelserna till kursutvecklarna.

Den utvalda kursen är engelskspråkig och indelad i sex moduler: (1) Overview/Introduction, (2) Description of the Solution, (3) Technical Background, (4) Product Description 1, (5) Product Description 2, och (6) Sales. Kursinnehållet omfattade totalt 24 webbsidor, plus några externa dokument, som kunde länkas från de 24 huvudsidorna. De två kursiterationerna som används i studien skiljer sig inte åt vad gäller innehållet. Det som ändrades består av instruktioner och möjligheter till feedback. Den största skillnaden mellan de två kursiterationerna var avsaknaden av feedback på svaren i övningsfrågorna och på sluttestet i den första iterationen. Grupp två, som tog den andra kursiterationen, fick feedback på vad de svarat fel i kontrast till vad som var rätt.

Multimetodansats: Den metodologiska ansatsen i den här studien har varit att försöka närma mig ämnesområdet på ett fördomsfritt sätt genom att använda flera metoder vid datainsamlingen, även kallad metodtriangulering (Yin, 2003). Ambitionen var att överbrygga kunskapsteoretiska paradigm och föra in flera perspektiv genom att använda olika forskningsmetoder (se t.ex. Turner, 2001; Volet, 2001) samt att på så sätt fånga både synlig och osynlig SRL (se tabell 1). Det är vanligt i pedagogisk designforskning att man blandar metoder för att bredda de explorativa möjligheterna i den valda kontexten. Samtidigt medför mångfalden av data att analysen blir både metodologiskt och tidsmässigt krävande. Mervärdet av en multimetodansats ligger i att data integreras i analysfasen (Onwuegbuzie, 2012; Creswell, Clark, Gutmann & Hanson, 2003), en så kallad datatriangulering (Yin, 2003). Analysen domineras främst av data från inspelade skärmobservationer och intervjuer. Dessa data kombinerades i ett arbetsdokument för att jämföra deltagarnas handlingar med deras reflektioner kring handlingarna. Förutom dessa metoder användes en förenkät (strategic flexibility questionnaire) som mätte hur deltagarna ansåg sig vara flexibla i sitt sätt att reglera lärande i olika situationer. Data från den enkäten användes i analysen för att jämföra om det fanns skillnader mellan gruppernas självuppfattade SRL, vilket t-test visade att det inte fanns. En andra enkät fylldes i efter kurssessionen (Reflecting on e-learning strategies questionnaire). Den användes som diskussionsunderlag i intervjun som även stimulerades av en genomgång av den bandade kurssessionen (skärmaktiviteten). Den andra gruppen hade dessutom tillgång till ögonrörelsedata. Deltagarnas hudkonduktans och puls mättes under kurssessionerna. Dessa data analyserades inte, men observerades under kurssessionens gång av forskaren. De fungerade som en indikation på hur deltagarna upplevde kursen och hade således en indirekt effekt på intervjun.

Resultat

Resultaten illustreras i figurerna 2 och 3, vilka är vidareutvecklingar av figur 1. På samma sätt som i figur 1 sätts fokus på beteende, kognition och affekt såsom områden av SRL. Figur 2 visar resultatet i förhållande till Hur-frågan och deltagarnas handlingar och varande, medan figur 3 utgår från Varför-frågan och deras intentioner bakom handlingarna[38]. Förutom de kontextuella faktorerna som presenterades i figur 1 hittades i studien en rad faktorer som utgjorde både *förutsättningar* och *begränsningar* och påverkade deltagarnas SRL. De här faktorerna är placerade i den grå ramen kring figurerna 2 och 3, eftersom de representerar externa faktorer utanför lärkontexten samt tidigare erfarenheter som deltagarna hade. Förutsättningar som påverkar deltagarnas SRL var *tidigare kunskaper om innehållet*, *tidigare erfarenhet av en liknande lärkontext* samt *epistemiska normer anammade från tidigare utbildningskulturer*. De här förutsättningarna utgjorde byggstenar för intresse för innehållet, vana att hantera digitala gränssnitt och förväntningar på förhållningsregler och bedömning i lärsituationen. Dessutom framkom ett antal begräsningar, som påverkade hur deltagarna hanterade lärsituationen, såsom tid, störande omgivningsfaktorer och fysiologiska begränsningar. I det följande beskriver jag kort de båda figurerna. Därefter går jag genom resultaten utgående från Hur- och Varför-perspektiven, men strukturerat enligt de tre SRL-områden beteende, kognition och affekt.

Hur? Deltagarnas handlingar och varande: ’Att göra’ handlar om beteendestrategier, dvs. aktiviteter för att hantera innehåll och kontext, kognitiva strategier för att hantera lärandet samt strategier för reglering av affekt och upprätthållande av motivation i kursarbetet. Affekt är dock mer än motivation, som i sig är starkt förknippat med målinriktning. Affekt, som ett område av SRL i en lärteknologisk kontext, handlar även om upplevelsen av varandet i själva kontexten. Här refererar jag till varandet som grund för användarupplevelsen och hur deltagarna i intervjun diskuterade användarupplevelsen av själva lärkontexten. Det är en blandning av både positiva och negativa emotioner, som en del av den totala lärupplevelsen.

Varför? Deltagarnas intentioner: Varför deltagarna agerade på vissa sätt under kursarbetet styrdes av deras intentioner, vilka även kan tolkas som variationer av ansatser för deras handlande. Det här indikerar deltagarnas målinriktning mot något, och är således sammankopplat med motivation för handlingar, även om det inte alltid sker på en medveten nivå. De olika ansatserna länkas till de tre SRL-områden (beteende, kognition och affekt) i figur 3, på samma sätt som i figur 2. I det följande beskriver jag resultaten i form av de kategorier av SRL på mikronivå (jfr Azevedo et al., 2010a, 2010b) som ingår i de två figurerna ovan.

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[38] I tidigare forskning av bland annat McKeachie, Pintrich, Ruohotie, DiPaolo och Susimetsä, för att nämna några, motsvarar de här två perspektiven motivation (varför) och lärstrategier (hur).
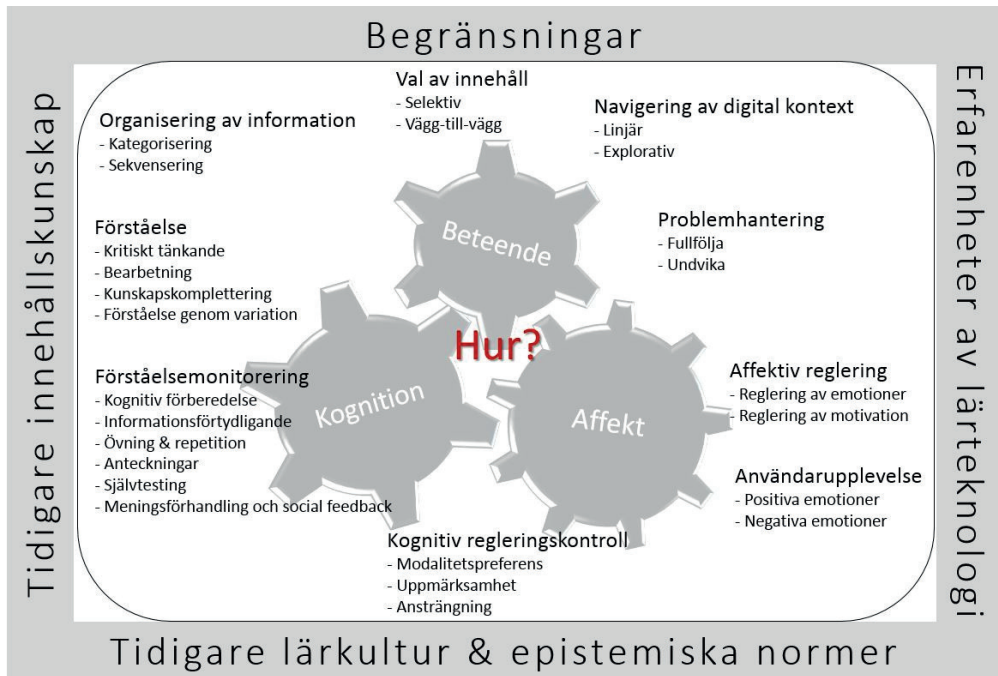
Figur 2 SRL-områden i relation till Hur-frågan.

Figur 3 SRL-områden i relation till Varför-frågan.

Beteende

Självreglering av beteendet i kursarbetet utgjordes av deltagarnas val av aktiviteter, vilket omfattade både val av innehåll och navigering i kontexten, men även hur de hanterade problem.

Handling: Hur gjorde deltagarna?

Navigering i digital kontext: Två olika sätt på vilka deltagarna navigerade i den digitala kontexten bestod av *linjär* kontra *explorativ* navigering. Deltagare som använde en linjär kontextnavigeringsstrategi gick genom kursen enligt den förbestämda strukturen av innehållet. De anpassade sig till en rytm av ett "Next-button"-navigeringsmönster och tog kursmodulerna i nummerordning: kursinstruktionerna styrde deras navigering. Deltagare som använde en explorativ kontextnavigeringsstrategi var mer självstyrda i sina val av lärstigar genom kursinnehållet. Variationen mellan dessa utgjorde samtidigt den största observerbara skillnaden som hittades i hur deltagarna i de båda kursiterationerna navigerade i kursen. I den första gruppen identifierades två tydliga sätt att hantera e-kursen: instruktionsstyrd navigering och självstyrd manipulering, av vilka den senare var det explorativa beteendet. I den andra gruppen fanns även explorativ navigering. Men här var det tydligt att det explorativa beteendet var feedbackstyrt. Även om den feedback deltagarna fick i den andra kursiterationen trots allt var relativt minimal, bidrog det ändå till att de lättare kunde avgöra var deras brister i kunskapen fanns och hur de kunde fylla dem. Feedbacken triggade dem till fortsatt handling och en explorativ navigering. Följaktligen ser feedback ut att vara en viktig stödfaktor för självreglering i lärprocessen, eftersom den hjälpte deltagarna att lättare identifiera sina styrkor och begränsningar i förhållande till innehållet samt att utforska kursmaterialet på ett mer målinriktat sätt. *Explorativ* navigering består således antingen av självstyrd manipulering eller feedbackstyrd utforskning. *Linjär* navigering är ett instruktionsstyrt navigeringsbeteende. Den avgörande betydelsen som feedback hade för hur deltagarna handlade (beteendet) för oss in på kognitionens område, och speciellt förståelsemonitorering. Jag återkommer till detta längre fram.

Val av innehåll: Val av innehåll gjordes *selektivt* av en del. De här deltagarna valde innehåll enligt sina egna behov och intresseområden och skippade resten av olika anledningar. De leddes därmed av en inre självstyrning i sina val av innehåll. Den andra strategin för val av innehåll, *vägg-till-vägg,* var den rakt motsatta till den selektiva strategin. De här deltagarna diskuterade sina val av innehåll från ett perspektiv att de försökte täcka hela kursinnehållet. Styrningen för en vägg-till-vägg-strategi kom antingen inifrån (intresse) eller utifrån (en uppfattning om yttre kontroll), men det framkom även att detta var en strategi som överfördes från tidigare sätt att hantera datorer.

Problemhantering: Hur deltagarna hanterade problem de stötte på (antingen relaterat till innehållet eller kontexten) kategoriserades även som strategier som hamnade inom

beteendeområdet. Två motsatta beteendestrategier hittades även här: *undvika* och *fullfölja*. De deltagare i grupp 1, som använde sig av en självstyrd manipuleringsstrategi, hade alla en fullföljarstrategi när de stötte på problem (t.ex. förvirring på grund av frånvaro av feedback på handlingar). En undvikande strategi innebar att deltagarna på olika sätt undvek att konfronteras med svårigheter och problem, såsom problem med mjukvara eller hårdvara, men även innehållsrelaterade problem som hade med förståelsen av materialet att göra. Det senare exemplet visar hur SRL-områden är interrelaterade i lärprocessen: problem att förstå (kognition) skapar negativa känslor (affekt) och resulterar i en undvikarstrategi (beteende). Följaktligen kan man dra slutsatsen att strategier för problemhantering är nära förknippade med förmågan att reglera affektiva tillstånd.

Intention: Varför valde deltagarna att göra som de gjorde?

Varför deltagarna valde att handla på olika sätt belyser deras intentioner bakom konkreta handlingar, till exempel varför de tog sig an kursen på ett visst sätt och varför de gjorde olika val av innehåll.

Ansats att närma sig kursen: Hur deltagarna först närmade sig kursen som helhet kunde kategoriserar i två ansatser: antingen med en *förberedande* ansats eller med en ansats som utgick från principen för *försök och misstag*. De här kategorierna representerade deltagarnas första inledande ansats hur de bemötte både kursinnehållet och den digitala kontexten. Ur ett processperspektiv på SRL (Puustinen & Pulkkinen, 2001) involveras initialt till exempel förtänksamhet, planering och aktivering i förberedelsefasen (Greene & Azevedo, 2009; Pintrich, 2005; Zimmerman, 2005). De som närmade sig kursinnehållet och/eller den digitala kontexten enligt försök och misstag-principen hoppade därmed mer eller mindre över förberedelsefasen. En ansats att närma sig kontexten genom försök och misstag relaterades av deltagarna till tidigare datorvana eller sätt att spela datorbaserade spel.

Ansats för val av innehåll: Två ansatser, som kunde härledas till hur deltagarna gjorde val relaterat till kursinnehållet var: *intresse baserat på nyhetens behag* och *pragmatisk användbarhet i jobbet*. Dessa representerar två olika bakomliggande intentioner som kan förliknas med deras målinriktning som grundar sig antingen på inre motivation triggad av eget intresse för något nytt, eller yttre motivation relaterat till arbetsuppgifter (jfr Deci & Ryan, 2000). Essensen av dessa intentioner överensstämmer med hur förberedelsefasen beskrivs av olika forskare; t.ex. som analys av uppgiften (Efklides, 2011; Zimmerman, 2005; Winne & Hadwin, 1998), analys av kontexten (Greene & Azevedo, 2009) eller analys av egen målsättning i studierna (Boekaerts, 1996).

Kognition

Inom pedagogisk design forskning har man historiskt sett fokuserat starkt på kognitiva strategier (Peters, 2013). Kognition är dock inte alltid kopplat till synliga aktiviteter.

Därmed är intervjuer viktiga för att fånga den subjektiva kognitiva upplevelsen och den osynliga delen av lärprocessen. De kognitiva aktiviteterna i lärandet relaterar till vad-frågan; dvs. innehållet och hur deltagarna handlar kognitivt för att förstå och lära.

Handling: Hur tänkte deltagarna?

I studien hittades tre huvudkategorier av den kognitiva processen: organisering av information, förståelse och integrering av kunskap, samt förståelsemonitorering (jfr Azevedo et al., 2010a, 2010b). Kognitiv regleringskontroll var även en del av den kognitiva processen, men kopplat till både beteende och affekt (jfr Pintrich, 2005).

Organisering av information: Enligt tidigare forskning (Tessmer & Jonassen, 1988; Weinstein, 2005; Weinstein & Meyer, 1991) handlar organisering av information om att strukturera och omstrukturera information så att man kan passa in den med tidigare kunskap, hitta de viktigaste idéerna och kategorisera den på olika sätt. Organisering av information i den här digitala lärkontexten visade att kognition är kopplad till beteende och inkluderade både *kategorisering* och *sekvensering* av innehållet. Det påverkade alltså även val av aktiviteter från ett beteendeperspektiv. Exempelvis värderades en del innehåll som viktigare och valdes därmed antingen före eller i stället för annat innehåll. En del deltagare valde innehåll i en viss ordning (sekvensering) för att underlätta förståelse. En dylik handling kan förknippas med reglering av uppmärksamhet och ansträngning, men även med förståelsemonitorering.

Förståelse och integrering av kunskap: I kategorin förståelse och integrering av kunskap hittades fyra underkategorier. Dessa kan skiljas åt utgående från hur deltagarnas kognitiva aktiviteter kunde identifieras och kategoriseras i relation till den pedagogiska designen. *Kunskapkomplettering* möjliggjordes genom både feedback och multimodala former av informationen. Dessa kontextuella egenskaper bidrog till att deltagarna målinriktat kunde söka information som lappade hål i deras kunskapsbas och bidrog till förståelse av innehållet (jfr Illeris, 2007 om kumulativt lärande). *Förståelse genom variation* var en annan mikronivåstrategi som deltagarna använde för att bygga förståelse. Genom att fokusera på variation i den presenterade informationen kunde de urskilja likheter och olikheter och på så vis skapa sig en fördjupad förståelse av innehållet. I det här fallet handlade det inte om variation i form av multimodalitet i presentationen av innehållet, utan om att presentera innehållet från olika perspektiv, t.ex. rätt och fel eller gammal och ny. Den här strategin handlade därmed om att jämföra och hitta kontraster i innehållet i stället för att bara addera ny information genom kunskapskomplettering (jfr Illeris, 2007 om assimilativt lärande). Två andra mikronivåstrategier som hör till förståelsekategorin är *kritiskt tänkande* och *bearbetning*. Dessa är inte på samma sätt direkt länkade till innehållets pedagogiska design, utan kan snarare kopplas till deltagarnas tidigare kunskap och förmåga att bearbeta informationen. Det består av en djupinriktad och kritisk bearbetning av innehållet i relation till deras arbete och expertis (jfr Illeris, 2007 om ackommodativt lärande).

Förståelsemonitorering: Kategorin förståelsemonitorering innebär kontroll och övervakning av förståelse för att utröna var problem finns och hur dessa kan överbryggas genom att hitta verktyg som hjälper en att förstå. Kategorin beskriver hur deltagarna övervakade och kontrollerade förståelse av innehållet och belyser därmed hur den pedagogiska designen kan riktas så att den stöder förståelseprocessen. *Kognitiv förberedelse* var ett sätt för deltagarna att kontrollera förståelsen och härrör till den första SRL-fasen (förberedelsefasen). Här bör påpekas igen att SRL är en dynamisk och cirkulär regleringsprocess som är kontinuerlig genom hela lärprocessen (Pintrich, 2005). Kognitiv förberedelse användes av deltagarna för att utvärdera och övervaka hur de skulle förhålla sig till och förstå informationen i lärmaterialet. *Informationsförtydligande* som underkategori till förståelsemonitorering var en strategi som deltagarna använde sig av vid en kognitiv konflikt och problem relaterat till förståelse av innehållet. Den här kognitiva strategin kan handla om att repetera delar av innehållet tills man förstår det. Varför man repeterar skiljer sig här från strategin *övning och repetition* med målet att memorera. Den skiljer sig även från den tidigare nämnda strategin kognitiv förberedelse, eftersom den innebär att man formar sig en förberedande uppfattning om något innan man går djupare in i det. *Anteckningar* beskrevs som ett annat sätt att repetera och kontrollera förståelse. Övningsfrågorna användes som *självtestning* för memorering och förståelse. Ytterligare en underkategori till förståelsemonitorering identifierades, nämligen *meningsförhandling och social feedback.* Några deltagare lyfte fram vikten av att diskutera sig fram till lösningar på problem i relation med andra. Kursen gav dock inte möjlighet till dylik social feedback och meningsförhandling, eftersom deltagarna var ensamma. Den här typen av kollektiv metakognitiv medvetenhet (Susimetsä, 2006) kom från deras tidigare erfarenheter av hur de lär sig på arbetsplatsen och av att ha stött på problem som inte har några enkla svar, där lösningen behöver förhandlas fram genom att spegla mångas uppfattningar. Skillnaden mellan kategorierna förståelse och förståelsemonitorering ligger i att den första består av mikronivåstrategier som bygger upp förståelsen, medan den andra består av mikronivåstrategier för att kontrollera och övervaka nivån av förståelse. Men att t.ex. göra anteckningar (som förståelsemonitoreringsstrategi) kan även användas för att bygga upp förståelsen och organisera innehållet genom att ta fasta på det man anser vara viktigast. Följaktligen kan man inte helt lätt separera och strikt kategorisera mikronivåstrategier. Jag har endast försökt definiera deras karaktärer och egenskaper för att förstå och belysa relationen de kan ha till den pedagogiska designen.

Kognitiv regleringskontroll: Deltagarna uttryckte hur de på olika sätt reglerade sig själva kognitivt för att optimera lärandet, vilket bestod av tre mikronivåstrategier deras förmåga att *upprätthålla ansträngning, rikta uppmärksamhet* eller *välja modaliteter enligt egen preferens.* De deltagare som diskuterade kognitiv regleringskontroll hade en metakognitiv medvetenhet om sina behov och preferenser. Metakognitiv självreglering beskrivs som medvetenhet och kunskap om samt kontroll av kognitionen. Exempel på detta är planering (målsättning och uppgiftsanalys) samt monitorering (följa ens uppmärksamhet, självtestning och korrigering av beteende) (Pintrich et al., 1991).

Denna kategori är nära kopplad till hur deltagarna hanterade motivation, affekt och val av handlingar (beteende) – inte förståelsen i sig.

Intention: Varför valde deltagarna att tänka som de gjorde?

Varför deltagarna valde att tänka på olika strategiska sätt belyser intentionens betydelse för val av kognitiva strategier. Eftersom kognition handlar om hur vi tänker för att förstå ett visst lärostoff, avslöjar intentionen bakom de kognitiva strategierna våra föreställningar om hur vi anser att kunskap konstrueras, dvs. vår epistemiska föreställning (Greene et al., 2010). Detta påverkar i sin tur vilken läransats vi anammar. Tidigare forskning kring läransats skiljer mellan djupa och ytliga läransatser (Marton et al., 1986), men även en prestationsinriktad läransats, som kan antingen vara ytlig eller djup (Biggs et al., 2001). Forskning visar att faktorer som påverkar läransats är t.ex. den pedagogiska designen och typen av bedömning (Biggs et al., 2001; Richardson, 2000), men även det omgivande sammanhanget som den lärande befinner sig i (Case & Marshall, 2004; Eklund-Myrskog, 1996). Följaktligen anpassar lärande sig till yttre omständigheter och krav. På så sätt kan man säga att val av lärstrategier är beroende av läransats (Marton et al., 1986; Richardson, 2000) och en betydande del av dessa härrör från kognitionen. Resultaten i föreliggande studie visar att typen av bedömning påverkade hur deltagarna valde att handla för att lära; deras läransats. Detta belyste ett nära samband mellan deras kognitiva strategier och deras intention. De två kategorierna av kognitiv ansats som hittades i studien, *memorering för prestation* och *förståelse för tillämpning,* kan jämföras med tidigare forskning kring yt- och djupinriktat lärande (t.ex., Marton et al., 1986). En del deltagare försökte memorera innehållet eller olika system för att komma ihåg ikryssningsalternativen i flervalsfrågorna. De memorerade för prestation, vilket innebar att drivkraften fanns utanför dem själva med fokus på sluttestet; så kallad yttre motivation för ytlig kunskap (Deci & Ryan, 2000). Vissa deltagare valde att ändra sin ansats till memorering för prestation, även om det låg i kontrast till deras epistemiska föreställning om kunskapsskapande. I den andra ansatsen låg fokus på att förstå innehållet för att kunna tillämpa det i ett senare skede och drivkraften kom från inre motivation för djup kunskap.

Affekt

Handling: Hur reglerade deltagarna affektiva tillstånd?

Hur deltagarna upplevde olika känslomässiga tillstånd i kursarbetet bestod av deras varande i förhållande till innehållet och lärkontexten. Både positiva och negativa emotioner utgör essensen i deras så kallade användarupplevelse av den digitala miljön och deras lärupplevelse av lärostoffet, medan deras handlingar i relation till affekt består av deras förmåga till emotionell självreglering och reglering av motivation. De positiva emotioner som deltagarna uttryckte var upprymdhet, frihetskänsla, intresse och aktivering. De negativa emotioner deltagarna upplevde var frustration, förvirring, osäkerhet, rädslor och ångest. Dessa emotioner triggades av olika faktorer som härrörde

antingen från dem själva, den pedagogiska designen av innehållet, den digitala kontexten eller från den tekniska lösningen.

Emotionell självreglering: I studien identifierades två affektbaserade ansatser till varför deltagarna valde att handla på olika sätt för att hantera innehållet i kursen. Det första tillvägagångssättet var att *undvika negativa känslor* genom att hålla sig på den säkra sidan eller genom att bara välja bekväma alternativ. Det andra tillvägagångssättet var att *röra sig mot det som skapar positiva känslor*, såsom saker som intresserade och motiverade dem. Det verkade som att en avsaknad av personlig investering och målsättning, avsaknad av pragmatiskt värde i uppgiften, men även problem med gränssnittets användarvänlighet, var faktorer som påverkade deltagarna mot att välja handlingar baserade på *säkerhet* och *bekvämlighet* för att undvika negativa känslor. En del deltagare undvek till exempel att ta del av innehåll som krävde en tvåstegsprocess för att få fram dokument. Det undvikande beteendet triggades av affektiva reaktioner, såsom negativa känslor av osäkerhet. Förmåga till emotionell självreglering inverkade därmed på hur de t.ex. löste problem.

Reglering av motivation: En motivationsregleringsstrategi var att söka efter stöd i den pedagogiska designen, t.ex. information om hur långt kursarbetet framskridit och vad som återstod. Här kan vi se hur reglering av motivation är länkat till upprätthållande av ansträngning och stöd i tidsplanering. En positiv känsla av kontroll kan skapas genom att den lärande ges information om mängden lärostoff som kvarstår. Motivation var en röd tråd som band ihop beteende, kognition och affekt genom hur deltagarna värderade uppgiften. Deltagarna analyserade kontinuerligt uppgifterna i innehållet i förhållande till deras betydelse och användbarhet för dem i verkliga livet. Det här är typiskt för vuxna lärande (Knowles et al, 1998). Analys av uppgiften utgör både utvärdering och reflektion före, under och efter prestationsfasen och är en pågående process genom hela lärsessionen. Uppgiftsanalysen är därmed en rekursiv process (Winne & Perry, 2005), som involverar alla tre faser av SRL (förberedelse-, prestations- och utvärderingsfasen). Efklides (2011) beskriver detta som en datastyrd botten-upp-självreglering på mikronivån, som leds av själva regleringen av uppgiften i stunden. Jag ser den här självregleringen som mer än bara datastyrd (innehållet), eftersom själva kontexten också påverkar regleringen och bearbetningen. Exempelvis hanterade deltagarna innehållet i relation till hur användbart det var för deras arbete, men även i enlighet med hur kontexten påverkade dem (t.ex. genom att väcka negativa känslor).

Användarupplevelse: Varför kände deltagarna som de gjorde?

Affekt i relation till design handlar om användarupplevelse (Hassenzahl, 2010). Analysen påvisade flera kategorier av negativa och positiva utlösande faktorer. Dessa kan delas in i *personliga faktorer, pedagogisk design av innehåll, design av den digitala kontexten* och *teknisk lösning*. I vissa av kategorierna är det tydligt att en utlösande faktor kan upplevas både som positiv och negativ av olika individer. Till exempel att möta ett

nytt format för lärande, såsom den här e-kursen, upplevdes av vissa deltagare som positivt, medan det för andra utlöste negativa emotioner.

Länken mellan kognition och affekt hittas i listan av negativa utlösande faktor som härrör från den pedagogiska designen av innehållet, såsom tvånget att memorera riklig information, för mycket text, överflödiga detaljer, och tvetydigt innehåll. Dylika faktorer tenderar att belasta vårt begränsade korttidsminne och på så sätt skapa negativa emotioner. Kognitiv belastning kan även utlösas av den digitala kontextens design, till den grad den ökar trycket på minne och perception (Kalyuga, 2011). I motsats till detta, hade positiva utlösande faktorer att göra med hur den digitala kontexten såg ut, t.ex. färger, men även hur den tillät interaktivitet och gav feedback. Till positiva utlösande faktorer på den här nivån kan räknas de som motverkade kognitiv belastning genom att stöda och underlätta förståelse och översikt av innehållet, men även det som stimulerade användarna att tänka, interagera och koppla innehållet till verkligheten. Det här är exempel på hur designen stöder förståelsen och dess monitorering, samt den kognitiva regleringen.

Förmåga till emotionell självreglering är en viktig del av lärprocessen och har visat sig påverka till exempel hur mycket man tycker om en kurs man tar (Ben-Eliyahu & Linnenbrink-Garcia, 2013). Utgående från resultatet kan även det omvända antas förekomma; att användarupplevelser av en e-kurs påverkar hur deltagarna engagerar sig och hur de förmår reglera sig emotionellt (jfr Azevedo & Aleven, 2013). Vad den tekniska lösningen beträffar, så är det enkelt att konstatera att alla former av brister i användbarhet och tillgänglighet skapar negativa emotioner.

Slutsatser

Ovan har jag diskuterat resultaten i enlighet med den teoretiskt förankrade ramen för den övergripande frågeställningen: hur kursens design påverkar deltagarnas handlingar och intentioner. I det följande diskuterar jag implikationer för pedagogisk design av digitala lärmiljöer i företag. Hur kan vi beakta betydelsen av lärupplevelsen och balansen mellan kognition och affekt? Vad är konsekvenserna av hur lärandet bedöms? Hur kan vi bäst beakta den speciella situation som utgörs av lärande i företag?

Konsekvenser av lärupplevelsen

Användarupplevelsekonceptet beskriver den totala upplevelsen av både innehållet och den digitala kontexten, men även slutanvändarens upplevelser som bottnar i dennes inre motivation för att lära sig innehållet (jfr Hassenzahl, 2010). Följaktligen är det viktigt att förstå hur kontextuella faktorer triggar och/eller hämmar positiva och negativa emotioner. Konsekvenserna av resultatet som härrör från användarupplevelse och affekt relaterar till hur vi kan designa för positiva emotioner och öka motivation. I det följande diskuterar jag designförslag i relation till resultaten.

Nyhetens behag, nyfikenhet och positiv förväntan: Deltagarna i studien var nyfikna på e-kursen som nytt format för hur man kan lära. Den här positiva förväntan hade att göra med nyhetens behag som den nya lärkontexten medförde. Men nyfikenhet diskuterades även i relation till innehållet i kursen; att det gav nya perspektiv på vad de redan visste. Genom att diskutera olikheter och skillnader i perspektiv redan i kursöversikten kan man trigga nyfikenhet och positiv förväntan. Designa med nyhetens behag, nyfikenhet och positiv förväntan i åtanke. Det har visat sig att det gör användarna positiva och uppiggade (Douglas-Cowie et al., 2005), vilket kan ha betydelse för att väcka inre motivation, som är viktig för både självregleringen och lärandet (Deci & Ryan, 2000).

Självständighet och frihet: En transparent översikt, alternativa navigeringsmöjligheter och snabb feedback ger användarna möjligheter att bli mer självstyrda i att välja en egen lärstig genom materialet i enlighet med egna behov och intressen. Det underlättar deras självständighet (jfr autonomi, Deci & Ryan, 2000) i att sätta egna mål. Designa för självständighet och frihet genom att ge användarna kontroll över situationen. Men det här måste gå hand i hand med att upprätthålla känslan av kompetens (Deci & Ryan, 2000) vad gäller hantering av innehållet och den digitala kontexten, men även lärprocessen. Viktiga aspekter här är flexibelt innehåll och en flexibel design, som låter användarna manipulera kontexten enligt egna behov och önskemål. Problemhantering bör också stödas. Det är dock en svår balansgång mellan att ge användaren kontroll- och frihetskänsla och samtidigt stöda på rätt sätt med instruktioner (Holmes, 2007).

Intresse och aktivering: Förmågan att upprätthålla intresse och hantera motivationen stöds av metaaffektiv medvetenhet; dvs. förmågan att reflektera över emotioner i lärsituationen. Tillgång till information om progress och förståelse underlättar reglering av motivation. Andra förslag på att designa för intresse och aktivering är multimodala representationer av innehållet, klara mål, exempel som illustrera informationen i relation till verkligheten, möjligheter att öva samt en estetiskt tilltalande digital design. Dessa faktorer ökade intresset hos och aktiverade deltagarna i undersökningen. Viktigast av allt är dock att innehållet är relevant för de behov målgruppen har i sin nuvarande arbetssituation. Vuxna lärande är pragmatiska i sin läransats (Brookfield, 1996; Conlan et al., 2003; Knowles et al., 1998), vilket framkom tydligt i studien.

Flexibilitet och individualisering: Hur deltagarna gjorde val i lärsituationen påverkades även av negativa och positiva emotioner. En del rörde sig bort från det som fick dem att känna tvivel eller reagera negativt, och i stället valde de att till exempel välja innehåll som de kände till sedan tidigare. Andra deltagare valde att möta utmaningarna de stötte på och ändå fylla kunskapsluckorna genom att rikta in sig på innehåll som var nytt för dem. Framförallt visade resultaten på att deltagarna alla var unika individer med unika behov och preferenser. Från ett designperspektiv belyses här vikten av anpassningsbar utformning av en pedagogisk design. Flexibelt innehåll och flexibilitet i kursmiljön, där målet är att låta användarna utgå från sina preferenser i lärsituationen, identifiera sina behov och intressen, och utforma egna mål. Vi kan inte undgå det faktum att de flesta digitala användare förväntar sig multimodalitet och flexibel tillgång till innehåll. Att inte

bygga på dessa möjligheter kommer troligen att påverka användarnas intressenivå. Forskning visar att innehåll som presenteras i form av statisk text på skärm kan fungera sämre i lärsituationer än om samma text är tryckt på papper (Murphy & Holleran, 2004). Digitalisering i sig är inget självändamål. Mervärdet med olika typer av lärdesign bör alltid identifieras i förhållande till målgrupp och sammanhang.

Feedback för självreglering: Föga överraskande visar forskning att digitalt lärande är mest framgångsrikt bland de individer som redan besitter en god förmåga till självreglering. Till exempel upptäckte Nahl (2012) att de som tillämpade metaaffektiv reflektion hade större benägenhet att omprioritera känslor och emotioner. På så vis kunde negativ affekt förminskas av att ha ett högre mål, vilket gjorde att individerna framhärdade med sina studier. Reflektion kring både affektiva och kognitiva reaktioner och bedömningar i relation till uppgiften är av vikt, men även reflektion kring kontexten. Feedback på övningsfrågorna stödde både kognitiv och affektiv reglering samt deltagares anpassning till miljön och självständighet i att skapa sin egen lärstig genom kursen. Feedback stödde även deltagare i att identifiera sina behov och kunskapsluckor i relation till innehållet. Även feedback i form av kontextuella signaler för framsteg i lärandet stödde motivationsreglering.

Konsekvenser av typen av bedömning

I e-kursen, som var föremål för den här undersökningen, bestod bedömningen av ett sluttest med 19 flervalsfrågor. Denna typ av bedömning av lärutfallet rekommenderas av vissa (Yost, 2002), medan andra avråder (Reed & Francis, 2001; Sims-Knight & Upchurch, 2001). Resultaten i denna studie bekräftar vikten av att vara medveten om hur olika typer av bedömning kan leda användarna till att tillämpa olika kognitiva läransatser. I enlighet med resultaten kan slutsatsen dras att flervalsfrågor kan fungera för dem som är tillräckligt självstyrda i sitt lärande. Samtidigt visade det sig att många triggades att börja manipulera miljön på olika sätt för att få tillräckligt många rätt svar i sluttestet, utan att bry sig om huruvida de förstod innehållet. De memorerade t.ex. visuellt hur kryssen ska ligga för att generera poäng. Det framkom också att även sådana deltagare som hade en inre motivation för att lära sig innehållet blev frustrerade på flervalsfrågorna när dessa ledde bort uppmärksamheten från innehållet till förmån för ett ytligt fokus på tecknen (se t.ex. Marton & Booth, 1997).

Baserat på resultaten i den här studien råder det inget tvivel om att de flesta pragmatiskt inriktade knappast kommer att ta till sig ett system där bedömningen känns överflödig och gör mer för att hindra lärande genom att tvinga användarna att memorera detaljer av fel anledning (vanligtvis för att innehållet inte har någon relevans i deras arbete). Därför är det viktigt att fråga vad den verkliga målsättningen med bedömningen är. Är det ett sätt att skapa en yttre kontroll av vem som har tagit kursen? Är det för att ge användarna ett verktyg att själva kontrollera vad de kan? Är det ett sätt att öva och repetera kunskap? Eller är alla ovannämnda orsaker relevanta? Design av lärande och

speciellt bedömning av lärande är egentligen en diskussion om makt (Kress & Selander, 2012).

Flervalsfrågor kan användas som alternativ om målsättningen är att öva och repetera. Dock behöver alternativen i frågorna vara lätta att urskilja från varandra, skrivna med ett enkelt språk, kort och koncist. Låt deltagarna välja att ta dem frivilligt, eftersom orsakerna till varför man tar en kurs kan variera och allt är inte lika viktigt för alla. Lita på att vuxna lärande själva kan ta ansvar och avgöra vikten av innehållet för just dem. Rigiditeten i systemet med flervalsfrågor frustrerade deltagarna och minskade deras upplevelse av autonomi (jfr Deci & Ryan, 2000) och kontroll över att självständigt få välja det som var viktigt för dem i deras arbete. I stället tvingades de kortsiktigt memorera detaljer för sluttestet, vilket utgör kärnan i det som kallas ytligt lärande. Då man designar bedömningen av lärande borde fokus sättas på relevansen som innehållet har för individens arbete. Rikta in bedömningen på själva lärprocessen i stället för på att memorera detaljer. Använd sociala nätverk för att diskutera. Kräv engagemang och interaktion bland deltagare och låt dem själva bygga kunskapsnätverk.

**Implikationer för lärande i företag**

Relevant kunskap motiverar: Deltagarna i studien ville ha tillämpbar kunskap. Denna uppfattning framkom tydligt bland alla deltagare. Värdet av innehållet för deras arbete var en stark motivationsfaktor och något som hjälpte dem att komma ihåg vad de lär sig. En deltagare i studien sa rakt på sak: *"[...] man kan se det, läsa det och förstå det. Men man kommer inte ihåg det"* om inte innehållet har relevans i det arbete man utför. På så sätt kan man säga att det värde man tillskriver ett innehåll kan ha avgörande betydelse för huruvida kunskapen överförs till långtidsminnet eller inte. En ökad förståelse för motivationsbaserad design för lärteknologiska lösningar växer fram med snabb takt. I t.ex. spelifiering av lärdesign ligger fokus på faktorer som i spel motiverar spelare att fortsätta. Man designar på så sätt för att stimulera hjärnans belöningscenter. En liknande utgångspunkt är också grunden i det som kallas upplevelsedesign (Hassenzahl, 2010). Här utgår man från fundamentala behov som motivationsfaktorer och använder dessa som riktlinjer i designen. Den rätta frågan att ställa då man designar kurser för lärande i företag är därmed varför någon skulle vilja eller behöva lära sig ett visst innehåll, och sedan låta svaret guida designen av lärupplevelsen (jfr Moore, 2009). Det handlar om balansen mellan mervärdet för företaget och individens motivation och bedömning av det pragmatiska värdet.

Konnektivism och social meningsförhandling: Siemens (2005) klargör i sin teori om konnektivism, att kunskap idag kan ses som en ständigt förändrande valuta. Vi har bäst framgång när vi vet vem vi ska vända oss till för att få kunskap och var vi hittar den senast uppdaterade kunskapen. Förändringen och fragmenteringen av kunskap är för stor för att vi själva ska kunna memorera allt. Min hypotes är att anställda i företag som själva bygger relationer kring för dem viktiga ämnen är mera framgångsrika än de som i isolerande kursmiljöer repeterar och memorerar kunskap som lätt blir föråldrad. En

del deltagare lyfte fram det faktum att det sällan finns enkla svar på problem i verkliga livet. Lösningar hittas bäst genom en bredare diskussion där meningsförhandling och social feedback underlättas och olika åsikter speglas för variationer av optimala lösningar. Ett mål med designen är att stöda djup reflektion – både individuellt i relation till eget arbete och i gemensamma förhandlingar med andra kring deras uppfattningar om innehållet.

Vad är det nya i digitala lärupplevelser?

Frågan kvarstår: Designar vi nya lärupplevelser i digitala miljöer? Enligt min uppfattning finns det nya aspekter och dimensioner att beakta i designen av digitala lärupplevelser. Dessa handlar speciellt om hur lärande kan stödas att utveckla designförankrad epistemisk metareflektion – och därmed digital kompetens. I en traditionell lärmiljö ger samspelet mellan människor både verbal och nonverbal bekräftelse för att stöda den cykliska självregleringen i lärprocessen. En digital lärkontext ska kompensera för bortfallet av mänsklig bekräftelse och feedback. I figuren nedan illustreras tre dimensioner som påvisar förhållandet mellan viktiga aspekter som ingår i dessa dimensioner.
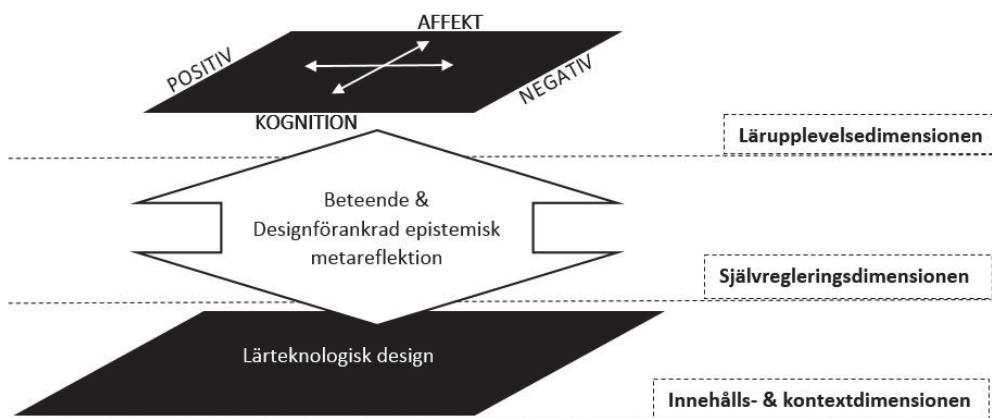
Figur 4 Dimensioner att beakta för att stöda självreglering.

Lärupplevelsedimensionen: Affekt och kognition är tätt sammanvävda i lärupplevelsen (Efklides, 2011; Fleckenstein, 1992; Kalyuga, 2011) och därmed mer eller mindre oskiljaktiga vad gäller deras påverkan på regleringen av lärandet (jfr Damásio, 1994; Goleman, 1995). Dessutom inkluderar lärupplevelsen positiva och negativa emotioner som ett resultat av användarupplevelsen i den digitala miljön (Hassenzahl, 2010) och i förhållande till lärostoffet. Följaktligen är lärupplevelsen en kombination av ett kognition-affekt kontinuum och ett spektrum av positiva och negativa upplevelser, vilket illustreras som korsande pilar i den övre dimensionen för lärupplevelsen i figuren.

Självregleringsdimensionen: Studiens resultat antyder att digital lärdesign kan stärka autonoma lärandes självreglering genom att stöda deras metakognitiva och metaaffektiva förmågor. Detta inkluderar medvetenhet och kontroll över tankeprocesser och emotioner som påverkar lärandet och deras motivation. Medvetenheten om detta kognition-affekt-kontinuum utgör grunden för den lärandes förmåga till metareflektion. Därtill innebär en epistemisk metareflektion hur de kan använda denna metareflektion för att reflektera över kunskapsbyggandet. Epistemisk metareflektion inkluderar därmed både metakognitiv och metaaffektiv förmåga (jfr Azevedo & Aleven, 2013; Ben-Eliyahu & Linnenbrink-Garcia, 2013). Genom att spegla den epistemiska metareflektionen i de förutsättningar och begräsningar en design har blir metareflektionen designförankrad, vilket möjliggör att den lärande kan reglera både affekt och kognition i förhållande till lärkontexten för att optimera sitt lärande. Detta ger grunden för goda val (beteende) i lärsituationen och stärker deras förmåga till självreglering i förhållande till både innehåll och kontext. Med andra ord är designförankrad epistemisk metareflektion en kärna i digital kompetens. Designförankrad epistemisk metareflektion kan stödas genom att designa för affektiv självreglering (t.ex. påvisa hur man kan reflektera över och hantera emotioner och motivation), kognitiv självreglering (t.ex. genom att erbjuda multimodala alternativ och leda uppmärksamheten på bästa sätt) och reglering av beteendet (t.ex. genom logisk navigering och tydliga instruktioner).

Innehålls- och kontextdimensionen: I lärteknologisk design skapas lärupplevelser där både innehåll och digital kontext sammanflätas till en oskiljaktig helhet. Däremot representerar de båda nivåerna av innehåll och kontext två olika lärprocesser som den lärande ska hantera parallellt. Dix et al. (1997) hänvisar till lärbarheten från ett kontextuellt perspektiv, som handlar om användbarhet av miljön och hur snabbt och intuitivt man kan lära sig att hantera den digitala kontexten. Innehållsperspektivet fokuseras i det som Nokelainen (2006) definierar som pedagogisk användbarhet. Det vill säga, hur bra ett lärteknologiskt verktyg hjälper den lärande att förstå innehållet. Förutom dessa två användbarhetsperspektiv, vill jag lyfta fram ett tredje perspektiv på användbarhet, som handlar om att stöda den lärandes utveckling av designförankrad epistemisk metareflektion. Den här designfaktorn – låt oss kalla den för metareflektiv användbarhet – förankras både i innehållet och kontexten, samt förbinder dessa med lärupplevelsedimensionen så som figuren visar.

References

Abbasi, A. R., Dailey, N. V., Afzulpurkar & Uno, T. (2013). Issues in automated facial expression analysis: comparing self, observer, and FaceReader interpretations. *Bahria University Journal of Information & Communication Technologies, 6*(1), 23-31.

Aleven, V., Roll, I., McLaren, B. M., & Koedinger, K. R. (2010). Automated, unobtrusive, action-by-action assessment of self-regulation during learning with an intelligent tutoring system. *Educational Psychologist, 45*(4), 224-233. DOI: 10.1080/00461520.2010.517740

Andrews, R., & Haythornthwaite, C. (2007). Introduction to e-learning research. In R. Andrews, & C. Haythornthwaite (Eds.), *The SAGE Handbook of E-Learning Research* (pp. 1-52). London, SAGE Publications Ltd.

Ausubel, D. P. (1963). *The psychology of meaningful verbal learning.* New York: Grune & Stratton.

Auvinen, A.-M. (2013). In search of a future learning concept. *SeOppi Magazine, eLEARNING IN FINLAND, 03.*

Azevedo, R. (2005). Computer environments as metacognitive tools for enhancing learning. *Educational Psychologist, 40*, 193-197. DOI: 10.1207/s15326985ep4004_1

Azevedo, R. (2007). Understanding the complex nature of self-regulated learning processes in learning with computer-based learning environments: An introduction. *Metacognition & Learning, 2*(2/3), 57–65.

Azevedo, R., & Aleven, V. (Eds.) (2013). Metacognition and learning technologies: An overview of current interdisciplinary research. In R. Azevedo, & V. Aleven (Eds.), *International Handbook of Metacognition and Learning Technologies* (pp. 1-16). Springer International Handbooks of Education, vol. 28. New York: Springer.

Azevedo, R., & Bernard, R. M. (1995). A meta-analysis of the effects of feedback in computer-based instruction. *Journal of Educational Computing Research, 13*(2), 111-127.

Azevedo, R., & Cromley, J. G. (2004). Does training on self-regulated learning facilitate students' learning with hypermedia? *Journal of Educational Psychology, 96*(3), 523-535.

Azevedo, R., Cromley, J. G., & Seibert, D. (2004). Does adaptive scaffolding facilitate students' ability to regulate their learning with hypermedia? *Contemporary Educational Psychology, 29*, 344-370. DOI: 10.1037/0022-0663.96.3.523

Azevedo, R., Harley, J., Trevors, G., Duffy, M., & Feyzi-Behnagh, R. (2013). Using Trace Data to Examine the Complex Roles of Cognitive, Metacognitive, and Emotional Self-Regulatory Processes During Learning with Multi-agent Systems. In R. Azevedo, & V. Aleven (Eds.), *International Handbook of Metacognition and Learning Technologies* (pp. 427-449). Springer International Handbooks of Education, Vol. 28.

Azevedo, R., Johnson, A., Burkett, C., Chauncey, A., Fike, A., Lintean, M., Cai, Z., & Rus, V. (2010b) The Role of Prompting and Feedback in Facilitating Students' Learning about Science with MetaTutor. *Proceedings of Cognitive and Metacognitive Educational Systems, AAAI Fall Symposium* 2010.

Azevedo, R., Landis, R. S., Feyzi-Behnagh, R., Duffy, M., Trevors, G., Harley, J., Bouchet, F., Burlison, J., Taub, M., Pacampara, N., Yeasin, M., Rahman, A. K. M. M., Tan-veer, M. I., & Hossain, G. (2011). The Effectiveness of Pedagogical Agents' Prompting and Feedback in Facilitating Co-Adapted Learning with MetaTutor. *Proceedings of the Intelligent Tutoring System, 11th Conference.* Berlin, Heidelberg: Springer-Verlag.

Azevedo, R., Moos, D. C., Johnson, A. M., & Chauncey, A. D. (2010a). Measuring cognitive and metacognitive regulatory processes during hypermedia learning: Issues and challenges. *Educational Psychologist, 45*(4), 210-223. Retrieved at: http://dx.doi.org/10.1080/00461520.2010.515934

Baker, L. (1979). Comprehension monitoring: Identifying and coping with text confusion. *Journal of Reading Behavior, 11,* 365-374. DOI: 10.1080/10862967909547342

Bandura, A. (1986). *Social Foundations of Thought and Action. A Social Cognitive Theory.* NJ: Prentice-Hall, Englewood Cliffs.

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control.* New York: Freeman.

Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *Journal of the Learning Sciences, 13*(1), 1-14. DOI: 10.1207/s15327809jls1301_1

Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O., & Lai, S. L. (2009). Measuring self-regulation in online and blended learning environments. *The Internet and Higher Education, 12,* 1-6.

Barnard-Brak, L., Lan, W. Y., & Paton, V. O. (2010). Profiles in self-regulated learning in the online learning environment. *International Review of Research in Open and Distance Learning, 11*(1), 61-80.

Batterbee, K. (2004). *Co-Experience. Understanding User Experiences in Social Interaction.* Academic Dissertation, University of Art and Design, Helsinki.

Bazeley, P. (2006). The contribution of computer software to integrating qualitative and quantitative data and analyses. *Research in the Schools, 13*(1), 64-74.

Bazeley, P. (2007). *Qualitative Data Analysis with NVivo.* Second Edition. Sage Publications.

Bazeley, P., & Kemp, L. (2012). Mosaics, triangles, and DNA: Metaphors for integrated analysis in mixed methods research. *Journal of Mixed Methods Research, 6*(1), 55-72.

Ben-Eliyahu, A., & Linnenbrink-Garcia, L. (2013). Extending self-regulated learning to include self-regulated emotion strategies. *Motivation & Emotion, 37,* 558-573.

Berger, C., & Kam, R. (1996). *Definitions of Instructional Design* [Online source at The University of Michigan, adapted from "Training and Instructional Design", Applied Research Laboratory at Penn State University]. Retrieved at: http://www.umich.edu/~ed626/define.html

Bernacki, M.L. Aguilar, A. & Byrnes, J. (2011). Self-regulated learning and technology-enhanced learning environments: an opportunity propensity analysis. In G. Dettori, & D. Persico (Eds.), *Fostering Self-Regulated Learning in ICTs* (pp. 1-26). Hershey, PA: IGI Global Publishers.

Bersin, J. (2004). Blended Learning: *The Blended Learning Book: Best Practices, Proven Methodologies, and Lessons Learned.* San Fransisco, CA: Pfeiffer.

Bevan, N. (2008). UX, usability and ISO standards. *Proceedings of CHI 2008*, Florence, Italy, 5-10 April.

Biggs, J. (1987). *Student Approaches to Learning and Studying.* Melbourne, Australian Council for Educational Research.

Biggs, J. (1994). Student learning research and theory – Where do we currently stand? In Gibbs, G. (Ed.), *Improving Student Learning Theory and Practice.* Oxford Centre for Staff Development, Oxford.

Biggs, J. B., Kember, D., & Leung, D. Y. P. (2001). The Revised Two Factor Study Process Questionnaire: R-SPQ-2F. *British Journal of Educational Psychology, 71,* 133-149.

Bjereld, U., Demker, M., & Hinnfors, J. (2009). *Varför vetenskap?* Lund: Studentlitteratur AB.

Blomberg, O. (2011). Conceptions of cognition for cognitive engineering. *International Journal of Aviation Psychology, 21*(1), 85-104.

Boekaerts, M. (1993). Being concerned with well-being and with learning. *Educational Psychologist, 28*(2), 149-167.

Boekaerts, M. (1996). Self-regulated learning at the junction of cognition and motivation. *European Psychologist, 1*(2), 100-112.

Boekaerts, M., & Cascallar, C. (2006). How far have we moved toward the integration of theory and practice in self-regulation. *Educational Psychology Review, 18*, 199-210.

Boekaerts, M., & Niemivirta, M. (2005). Self-regulated learning: Finding a balance between learning goals and ego-protective goals. In M. Boekaerts, P. R. Pintrich, & M. Zeidner, (Eds.), *Handbook of Self-Regulation,* 2nd ed. (pp. 417-450). San Diego, CA: Academic Press.

Boekaerts, M., Pintrich, P. R., & Zeidner, M. (Eds.) (2005). *Handbook of Self-Regulation,* 2nd ed. San Diego, CA: Academic Press.

Borkowski, J. G. (1996). Metacognition: Theory or chapter heading? *Learning and Individual Differences, 8,* 391-402.

Brand-Gruwel, S., Kester, L., Kicken, W., & Kirschner, P. A. (2014). Learning ability development in flexible learning environments. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of Research on Educational Communications and Technology* (pp. 363-372). New York: Springer.

Brannen, J. (2005). Mixing methods: The entry of qualitative and quantitative approaches into the research process. *International Journal of Social Research Methods, 8,* 173-184.

Bronfenbrenner, U. (1994). Ecological models of human development. In T. Husen, & T. N. Postlethwaite (Eds.), *International Encyclopedia of Education,* 2nd ed., Vol. 3, (pp. 1643–1647). Oxford: Pergamon Press.

Brookfield, S. D. (1996). Adult learning: An overview. In A. C. Tuijnman (Ed.), *International Encyclopedia of Adult Education and Training,* (pp. 375-380). Oxford: Elsevier.

Brown, A. (1992). Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings. *The Journal of the Learning Sciences*, *2*(2), 141-178.

Brown, J. S, Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Education Researcher, 18,* 32-42.

Bruner, J. S. (1971). *På väg mot en undervisningsteori.* Lund: Gleerups.

Bruner, J. S. (1990). *Acts of Meaning.* Cambridge, MA: Harvard University Press.

Burge, E. J. (Ed.) (2001). *The Strategic Use of Learning Technologies: New Directions for Adult and Continuing Education.* San-Francisco: Jossey-Bass.

Burleson W. (2013). Affective Learning Companions and the Adoption of Metacognitive Strategies. In R. Azevedo, & V. Aleven (Eds.), *International Handbook of Metacognition and Learning Technologies* (pp. 645-657). Springer International Handbooks of Education, Vol. 28.

Campbell, T. (1996). Technology, multimedia, and qualitative research in education. *Journal of Research on Computing in Education, 30*(9), 122-133. Doi: 10.1080/08886504.1997.10782219

Cantwell, R. H., & Moore, P. J. (1996). The development of measures of individual differences in self-regulatory control and their relationship to academic performance. *Contemporary Educational Psychology, 21*, 500-517.

Carneiro, R. (2005). Self-regulated learning in technology enhanced learning environments: a view from the industry. In R. Carneiro, K. Steffens, & J. Underwood (Eds.), *Self-regulated learning in technology enhanced learning environments.* Proceedings of the TACONET conference, Lisbon, 23 September.

Case, J., & Jawitz, J. (2004). Using situated cognition theory in researching student experience of the workplace. *Journal of Research in Science Teaching, 41*(5), 415-431.

Case, J., & Marshall, D. (2004). Between deep and surface: Procedural approaches to learning in engineering education contexts. *Studies in Higher Education, 29*(5), 605-615. Doi: 10.1080/0307507042000261571

Clark, R. C., & Mayer, R. E. (2002). *E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning.* San Francisco, CA. Pfeiffer.

Coles, G. (1999). *Literacy, emotions, and the brain* [online posting adapted from material in the author's *Reading Lessons: The Debate over Literacy*. New York: Hill & Wang, 1998]. Retrieved at: http://www.readingonline.org/critical/coles.html

Conlan, J., Grabowski, S., Smith, K. (2003). Current trends in adult education [book chapter online]. In M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technology.* Retrieved at: http://www.coe.uga.edu/epltt/AdultEducation.htm

Cordingley, A., Lai, Y. C., Pemberton, M., Smith, J., & Volet, S. (1998). Regulation of learning in vocational education: An exploratory study. *Issues in Educational Research, 8*(1), 15-32.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: Sage publications.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced Mixed Methods Research Designs. In A. Tashakkori, & C. Teddlie (Eds.), *Handbook of Mixed Methods in Social and Behavioral Research* (pp. 209-240). Thousand Oaks, CA: Sage Publications, Inc.

Cronbach, L. J. (1975). Beyond the two disciplines of scientific psychology. *American Psychologist, 30*(2), 116-127.

Curry, L. (1983). An organisation of learning style theory and constructs. In L. Curry (Ed.)*, Learning Style in Continuing Education.* Canada, Dalhousie University.

Damasio, A. R. (1994). *Descartes' Error: Emotion, Reason, and the Human Brain*. New York: G.P. Putnum's Sons.

Das, J. P. (1988). Simultaneous-successive processing and planning: Implications for school learning. In R. Schmeck (Ed.), *Learning strategies and learning styles* (pp. 101-130). New York: Plenum Press.

Davis, R., & Wong, D. (2007). Conceptualizing and measuring the optimal experience of the eLearning environment. *Decision Sciences Journal of Innovative Education, 5*(1), 97-126.

Deci, E. L., & Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227-268.

Deimann, M. & Keller, J. (2006). Volitional Aspects of Multimedia Learning. *Journal of Educational Multimedia and Hypermedia, 15*(2), 137-158. Chesapeake, VA: AACE.

Dettori, G. (2013). Demystifying self-regulated learning. *Future Learning, 1*, 55-59. DOI: 10.7564/13-FULE17

Di Paolo, T. (2001). *An Investigation of Students' Computer-Based Learning Strategies.* Dissertation. UK: Open University.

Dix, A. J., Finlay, J. E., Abowd, G. D., & Beale, R. (1997). *Human-Computer Interaction* (2nd ed.). Glasgow: Bath Press Colourbooks.

Dogusoy, B., & Cagiltay, K. (2009). An innovative way of understanding learning processes: eye tracking. In J. A. (Ed.), *Human-Computer Interaction, Part IV, HCII 2009, LNCS 5613* (pp. 94-100). Berlin Heidelberg: Springer-Verlag.

Douglas-Cowie, E., Devillers, L., Martin, J-C., Cowie, R., Savvidou, S., Abrilian, S., & Cox, C. (2005). Multimodal databases of everyday emotion: Facing up to complexity. In *Proceedings of InterSpeech,* Lisbon, September.

Duffy, T. M., & Jonassen, D. H. (Eds.) (1992). Constructivism: New implications for instructional technology. In T. M. Duffy, & D. H. Jonassen (Eds.), *Constructivist and the Technology of Instruction: a Conversation* (pp. 1-16). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Duffy, T. M., Lowyck, J. & Jonassen, D. H. (Eds.) (1993), *The Design of Constructivistic Learning Environments: Implications for Instructional Design and The Use of Technology.* Heidelberg, FRG: Springer-Verlag.

Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*, 1040-1048.

Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: The MASRL model. *EDUCATIONAL PSYCHOLOGIST, 46*(1), 6–25.

Efklides, A., & Volet, S. (2005). Emotional experiences during learning: Multiple, situated and dynamic. *Learning and Instruction, 15*(5), 377–380.

Egloff, B., Schmukle, S.C., Burns, L.R., Kohlmann, C-W., & Hock, M. (2003). Facets of dynamic positive affect: differentiating joy, interest, and activation in the positive and negative affect schedule (PANAS). *Journal of Personality and Social Psychology, 85*(3), 528-540.

Eklund-Myrskog, G. (2003). What is learning for me and how do I learn. In J. Sjöberg, H. Andersson, & O. Björkqvist (Eds.), *Läraren och pedagogiken. Festskrift tillägnad Sven-Erik Hansén* (pp. 151-163). Åbo, Finland: Åbo Akademis Förlag.

Entwistle, N. (1986). Olika perspektiv på inlärning. In F. Marton, D. Hounsell, & N. Entwistle (Eds.), *Hur vi lär* [How we learn]. Kristianstad, Kristianstads Boktryckeri AB.

Ertmer, P., Parisio, M., Wardak, D. (2013). The practice of educational/instructional design. In R Luckin, S Puntambekar, P. Goodyear, B. Grabowski, J. Underwood, & N. Winters (Eds.), *Handbook of Design in Educational Technology* (pp. 5-19). New York: Routledge.

Feuerstein, Ra. S. (2000). Dynamic cognitive assessment and the instrumental enrichment program: Origins and development. In A. Kozulin and Y. Rand, (Eds.), *Mediated Learning Experience: Theoretical, Psychological, and Learning Implications* (pp. 147-165). Amsterdam: Pergamon.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*, 906 - 911.

Fleckenstein, K. S. (1992). Defining affect in relation to cognition: A response to Susan McLeod. *Journal of Advanced Composition, 11*(2), 447-53.

Flick, U. (2004). Triangulation in Qualitative Research. In U. Flick, E. v. Kardorff, & I. Steinke (Eds.), *A Companion to Qualitative Research* (pp. 178-183). London: Sage.

Forehand, M. (2005). Bloom's taxonomy: Original and revised [book chapter online]. In M. Orey (Ed.), Emerging perspectives on learning, teaching, and technology. Retrieved at: http://www.coe.uga.edu/epltt/bloom.htm

Franchi, S., & Bianchini, F. (2011). On the historical dynamics of cognitive science: a view from the periphery. In. S. Franchi, & F. Bianchini. *The Search for a Theory of Cognition. Early Mechanisms and New Ideas.* Amsterdam: Rodopi.

Gagne, R. M. & Briggs, L. J. (1974). *Principles of Instructional Design.* New York: Holt, Rinehart and Winston.

Gagne, R. M. (1985). *The Conditions of Learning and Theory of Instruction.* New York: CBS College Publishing.

Gagnè, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. (2005). *Principals of Instructional Design*, 5th ed. Belmont, CA: Wadsworth/Thomson Learning.

Garrison, D. R., & Anderson, T. (2003). *E-learning in the 21st Century: A Framework for Research and Practice*. London: Routledge Falmer.

Garvin, D. A., Edmondson, A. C., & Gino, F. (2008). Is Yours a Learning Organization? *Harvard Business Review*. Retrieved at: http://provost.tufts.edu/celt/files/Is-Yours-a-Learning-Organization-by-Garvin-Edmondson-and-Gino.pdf

Garzotto, F., Retalis, S., Cantoni, I., & Papasalouros A. (2004). Patterns for designing adaptive/adaptable educational hypermedia. *In First International Workshop on Authoring of Adaptive and Adaptable Educational Hypermedia, Proceedings of the Third IASTED International Conference on Web-Based Education*, Innsburg, Austria, February.

Gibson C. C. (1998). *Distance Learners in Higher Education: Institutional Responses for Quality Outcomes.* Madison, WI: Atwood Publishing.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4), 597-607. Retrieved at: http://www.nova.edu/ssss/QR/QR8-4/golafshani.pdf

Goleman, D. (1995). Emotional Intelligence: Why it can matter more than IQ? New York, NY, USA. Bantam Books, Inc.

Goodyear, P., & Ellis, R. (2010). Expanding conceptions of study, context and educational design. In R. Sharpe, H. Beetham, & S. de Freitas (Eds.), *Rethinking learning for the digital age: how learners shape their own experiences* (pp. 100-113). New York: Routledge.

Greene, J. A., & Azevedo, R. (2007). A theoretical review of Winne and Hadwin's model of self-regulated learning: New perspectives and directions. *Review of Educational Research, 77*(3), 334-372.

Greene, J. A., & Azevedo, R. (2009). A macro-level analysis of SRL processes and their relations to the acquisition of a sophisticated mental model of a complex system. *Contemporary Educational Psychology, 34,* 18-29.

Greene, J. A., & Azevedo, R. (2010). Introduction: The measurement of learners' self-regulated cognitive and metacognitive processes while using computer-based learning environments. *Educational Psychologist, 45*(4), 203-209.

Greene, J. A., Dellinger, K., Binbasaran Tuysuzoglu, B., & Costa, L. (2013). A two-tiered approach to analyzing self-regulated learning process data to inform the design of hypermedia learning environments. In R. Azevedo, & V. Aleven (Eds.), *International Handbook of Metacognition and Learning Technologies* (pp. 117-128). New York: Springer.

Greene, J. A., Muis, K. R., & Pieschl, S. (2010). The role of epistemic beliefs in students' self-regulated learning with computer-based learning environments: Conceptual and methodological issues. *Educational Psychologist*, 45(4), 245-257.

Guan, Z., Lee, S., Cuddihy, E., & Ramey, J. (2006). The validity of the stimulated retrospective think-aloud method as measured by eye tracking. *CHI '06 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1253-1262, ACM, New York.

Hamlett, C. H. (2006). *Self-directed learning and achievement in a blackboard-based college algebra course.* Doctoral Dissertation, Walden University, USA.

Hanif, A., Ferrey, A. E., Frischen, A., Pozzobon, K., Eastwood, J. D., Smilek, D., Fenske, M. J. (2012). Manipulations of attention enhance self-regulation. *Acta Psychologica, 139*(1), 104-110.

Hannafin, M. J., Hannafin, K., Land, S. M., & Oliver, K. (1997). Grounded Practice and the Design of Constructivist Learning Environments. *Educational Technology Research and Development, 45*(3), 101-117.

Harnishfeger, K. K. & Bjorklund, D. F. (1990). Children's strategies: A brief history. In D.F. Bjorklund (Ed.), *Children's strategies: Contemporary views of cognitive development* (pp 1-22). Hillsdale, NJ: Erlbaum.

Hassenzahl, M. (2001). The effect of perceived hedonic quality on product appealingness. *International Journal of Human-Computer Interaction, 13*(4), 481-499.

Hassenzahl, M. (2008). User Experience (UX): Towards an experiential perspective on product quality. *Keynote in IHM '08: Proceedings of the 20th French-speaking conference on Human-computer interaction (Conférence Francophone sur l'Interaction Homme-Machine).*

Hassenzahl, M. (2010). *Experience design: Technology for all the right reasons.* San Rafael, California: Morgan & Claypool.

Haythornthwaite, C. (2007). Social networks and online community. In A. Joinson, K. McKenna, U. Reips & T. Postmes (Eds.), *Oxford Handbook of Internet Psychology* (pp. 121-136). Oxford University Press.

Herrington, A., Herrington, J., & Mantei, J. (2009). . In J. Herrington, A. Herrington, J. Mantei, I. Olney, & B. Ferry (Eds.), *New Technologies, New Pedagogies: Mobile Learning in Higher Education Design Principles for Mobile Learning* (pp. 129-138). University of Wollongong, Wollongong.

Hoadley, C. (2007). Learning sciences theories and methods for e-learning research. In R. Andrews & C. Haythornthwaite (Eds.), *The SAGE Handbook of E-Learning Research* (pp. 221-247). London: SAGE Publications Ltd.

Hockenbury, D. H., & Hockenbury, S. E. (2007). *Discovering Psychology.* New York: Worth Publishers.

Hodkinson, P., & Macleod, F. (2007). Contrasting concepts of learning and contrasting research methodologies. *Proceedings of Educational Research and TLRP Annual Conference Cardiff.*

Hoepfl, M. C. (1997). Choosing qualitative research: A primer for technology education researchers. *Journal of Technology Education, 9*(1), 47-63.

Holmes, J. (2007). Designing agents to support learning by explaining. *Computers & Education, 48*(4), 523-547.

Hung, D. W. L., & Der-Thanq, C. (2001). Situated Cognition, Vygotskian Thought and Learning from the Communities of Practice Perspective: Implications for the Design of Web-Based E-Learning. *Educational Media International, 38*(1), 3-12.

Hyrskykari, A., Ovaska, S., Majaranta, P., Räihä, K.-J. & Lehtinen, M. (2008). Gaze path stimulation in retrospective think-aloud. *Journal of Eye Movement Research, 2(*4):5, 1-18.

Illeris, K. (2007). *Lärande.* Lund: Studentlitteratur.

IQ Form. University of Helsinki, Finland. http://iqform.edu.helsinki.fi (23/11/05).

Jahnke, I., & Kumar, S. (2014). Digital didactical designs: Teachers' integration of iPads for learning-centered processes. *Journal of Digital Learning in Teacher Education, 30*(3), 81-88.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Research. 33*, 14-26.

Jonassen, D. H. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.). *Instructional-Design Theories and Models: A New Paradigm of Instructional Design* (pp. 215-239). Mahwah, NJ: Erlbaum.

Jonassen, D. H. (2000). Transforming learning with technology: Beyond modernism and post-modernism or whoever controls the technology creates the reality. *Educational Technology*, *40*(2), 21-25.

Jonassen, D. H., & Land, S. M. (Eds.) (2000). *Theoretical Foundations of Learning Environments.* Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.

Jonassen, D. H., Dyer, D., Peters, K., Robinson, T., Harvey, D., King, M., & Loughner, P. (1997). Cognitive flexibility hypertexts on the web: engaging learners in meaning making. In B. H. Khan (Ed.) *Web-Based Instruction* (pp. 119-133). Englewood Cliffs, NJ: Educational Technology Publications.

Joy, E. H., & Garcia, F. E. (2000). Measuring learning effectiveness: A new look at no-significant-difference findings. *Online Learning (formerly the Journal of Asynchronous Learning Networks, JALN) 4*(1), 33-39.

Järvelä, S. & Niemivirta, M. (2001). Motivation in context: challenges and possibilities in studying the role of motivation in new pedagogical cultures. In S. Volet, & S. Järvelä (Eds.), *Motivation in Learning Contexts: Theoretical Advances and Methodological Implications* (pp. 105-127). London: Pergamon/Elsevier.

Järvelä, S. (2001). Shifting research on motivation and cognition to an integrated approach on learning and motivation in context. In S. Volet, & S. Järvelä (Eds.). *Motivation in Learning Contexts: Theoretical Advances and Methodological Implications* (pp. 3-14). Oxford: Pergamon.

Järvelä, S. (2010), Socioemotional aspects of technology-supported learning. In: Penelope Peterson, Eva Baker, Barry McGaw, (Eds.), *International Encyclopedia of Education,* Volume 6, (pp. 718-723). Oxford: Elsevier.

Järvelä, S., Hurme, T.-R., & Järvenoja, H. (2011). Self-regulation and motivation in computer supported collaborative learning environments. In S. Ludvigsen, A. Lund, I. Rasmussen, & R. Säljö, (Eds.), *Learning Across Sites. New Tools, Infrastructures and Practices* (pp. 330-345). Oxford: Routledge.

Järvelä, S., Näykki, P., Laru, J., & Luokkanen, T. (2007). Structuring and regulating collaborative learning in higher education with wireless networks and mobile tools. *Journal of Educational Technology & Society 10*(4), 71-71.

Järvelä, S., Volet, S., & Järvenoja, H. (2010). Research on motivation in collaborative learning: Moving beyond the cognitive-situative divide and combining individual and social processes. *Educational Psychologist, 45*(1), 15-27.

Järvenoja , H., Volet, S., & Järvelä, S. (2013). Regulation of emotions in socially challenging learning situations: an instrument to measure the adaptive and social nature of the regulation process, *Educational Psychology: An International Journal of Experimental Educational Psychology, 33*(1), 31-58. DOI: 10.1080/01443410.2012.742334

Järvenoja, H., & Järvelä, S. (2005). How the students explain their social, emotional and motivational experiences during their learning processes. *Learning and Instruction, 15,* 465-480.

Kalyuga, S. (2011). Cognitive load theory: Implications for affective computing. In R. Charles Murray, & P. M. McCarthy (Eds.), *Proceedings of the Twenty-Fourth International Florida Artificial Intelligence Research Society Conference.*

Keller, J. M. (1983). Motivational design of instruction. In C. M. Reigeluth (Ed.), *Instructional-Design Theories and Models: An Overview of Their Current Status* (pp. 383–434). Hillsdale, NJ: Lawrence Erlbaum Associates.

Keller, J. M. (2010). *Motivational design for learning and performance: The ARCS Model Approach.* Springer.

Kerlin, B. A. (1992). Cognitive engagement style, self-regulated learning and cooperative learning. *TEACH 2000 - The educators' guide to the Internet and World Wide Web.* http://kerlins.net/bobbi/research/myresearch/srl.html (23/11/05).

Khan, B. H. (1997). Web-based instruction: What is it and why is it? In B. H. Khan (Ed.), *Web-based instruction* (pp. 5-18). Englewood Cliffs, NJ: Educational Technology Publications.

Khan, B. H. (2003). Distributed learning framework. In I. Kabakci, & Z. Karakaya (Eds.), *WEB'de OGRENME.* Ankara, Turkey: Türkiye Bilişim Derneği.

Kikuchi, H. (2006). Motivational factors affecting online learning by Japanese MBA students. *Australasian Journal of Educational Technology, 22*(3), 398-415.

Kim, K. J. (2009). Motivational Challenges of Adult Learners in Self-Directed e-Learning. *Journal of Interactive Learning Research, 20*(3), pp. 317-335. Chesapeake, VA: AACE.

Kjällander, S. (2011). *Designs for learning in an extended digital environment: Case studies of social interaction in the social sciences classroom.* Dissertation. Department of Education, Stockholm University.

Knight, B. A., & Horsley, M. (2014). A New Approach to Cognitive Metrics: Analysing the Visual Mechanics of Comprehension using Eye-Tracking Data in Student Completion of High-Stakes Testing Evaluation. In M. Horsley, N. Toon, B. Knight, & R. Reilly (Eds.), *Current Trends in Eye Tracking Research* (pp. 287-296). Springer-Verlag.

Knowles, M. S., Holton, E. F. III, Swanson, R. A. (1998). *The adult learner: The definitive classic in adult education and human resource development.* 5th ed. Houston, Texas: Gulf Publishing Company.

Koehler, M. J., & Mishra, P. (2008). Introducing TPCK. In AACTE Committee on Innovation and Technology (Ed.), *The Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators* (pp. 3-29), New York: American Association of Colleges of Teacher Education and Rougledge.

Kress, G. (2010). *Multimodality: A Social Semiotic Approach to Contemporary Communication.* London: Routledge.

Kress, G., & Selander, S. (2012). Multimodal design, learning and cultures of recognition. *Internet and Higher Education*, 15. p. 265-268. Doi:10.1016/j.iheduc.2011.12.003

Kroksmark, T. (2011). Lärandets stretchadhet. Lärandets digitala mysterium i En-till-En-miljöer i skolan. *Didaktisk Tidskrift, 20*(1), 1-22.

Kuhl, J. (1985). Volitional mediators of cognition-behaviour consistency: Self-regulatory processes and action versus state orientation. In J. Kuhl, & J. Beckmann (Eds.), *Action Control: From Cognition to Behaviour* (pp. 101-128). New York: Springer.

Kuhl, J. (1987). Action control: The maintenance of motivational states. In F. Halish, & J. Kuhl (Eds.), *Motivation, intention, and volition* (pp. 279-291). Berlin: Springer.

Kvale, S. (1997). *Den kvalitativa forskningsintervjun* [InterViews: An Introduction to Qualitative Research Interviewing]. Lund: Studentlitteratur AB.

Land, S., & Hannafin, M. J. (2000). Student-centered learning environments. In D. H. Jonassen, & S. M. Land (Eds.), *Theoretical Foundations of Learning Environments* (pp. 1–23). Mahwah, NJ: Erlbaum.

Larsson, M. (2001). *Fem faktorer för effektivare e-lärande* [Five factors for effective e-learning] D-uppsats. Department of Philosophy, Cognitive Science, Lund University.

Leahy, W., Cooper, G., & Sweller, J. (2004). Interactivity and the constraints of cognitive load theory. In A. Peacock, & A. Cleghorn (Eds.), *Missing the Meaning: The Development and Use of Print and Non-Print Text Materials in Diverse School Settings* (pp. 89-104). New York: Palgrave MacMillan.

Lee, J. K. (2004). *The effect of e-Learning environmental quality and self-efficacy on effectiveness of an e-Learning.* Business Administration Doctoral Dissertation, Daegu University.

Lee, J. K. (2009). The effects of self-regulated learning strategies and system satisfaction regarding learner's performance in e-learning environment. *Journal of Instructional Pedagogics, 1,* 30-45.

Lee, J. K., Hwang, C. Y. (2007). The effects of computer self-efficacy and learning management system quality on e-Learner's satisfaction. In L. Cameron, A. Voerman, & J.Dalziel (Eds.), *Proceedings of the 2007 European LAMS Conference: Designing the future of learning* (pp. 73-79). 5 July, Greenwich: LAMS Foundation.

Lee, W. W., Owens, D. L., & Benson, A. D. (2002). Design considerations for web-based learning systems. *Advances in Developing Human Resources, 4*(4), 405-423.

LeFrere, P. (2005) Self-regulated learning in technology enhanced learning environments: relevance to industry needs and practice. In R. Carneiro, K. Steffens, & J. Underwood (Eds.), *Self-Regulated* Learning in Technology Enhanced Learning Environments (pp. 16-20). Proceedings of the TACONET Conference Lisbon, 23 September. Shaker Verlag.

Lilja, P., & Lindström, B. (2002). Vad ska man ha den till då? Om konstruktionistisk teknologi och lärande i skolans värld. In R. Säljö, & J. Linderoth (Eds.) *Utmaningar och e-frestelser: it och skolans lärkultur.* Stockholm: Bokförlaget Prisma.

Lindseth, A., & Norberg, A. (2004). A phenomenological hermeneutical method for researching lived experience. *Scandinavian Journal of Caring Science, 18,* 145-153.

Lyle, J. (2003). Stimulated Recall: a report on its use in naturalistic research. *British Educational Research Journal, 29*(6), 861-878.

Mahoney, M. J. (2004). What is constructivism and why is it growing? *Contemporary Psychology, 49,* 360-363.

Marton, F., & Booth, S. (1997). *Learning and Awareness.* Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Marton, F., & Säljö, R. (1976). On qualitative differences in learning: outcome and process. *British Journal of Educational Psychology*, *46,* 4-11.

Marton, F., & Säljö, R. (1986). Kognitiv inriktning vid inlärning [A cognitive perspective on learning]. In F. Marton, D. Hounsell, & N. Entwistle (Eds.), *Hur vi lär* [How we learn]. Kristianstad: Kristianstads Boktryckeri AB.

Marton, F., Dall'Alba, G., & Beaty, E. (1993). Conceptions of learning. *International Journal of Educational Research, 19*, 277-300.

Marton, F., Hounsell, D., & Entwistle, N. (1986). *Hur vi lär* [How we learn]. Kristianstad: Kristianstads Boktryckeri AB.

Mason, B. J., & Bruning, R. (no date). *Providing Feedback in Computer-based Instruction: What the Research Tells Us* [online paper, Center for Instructional Innovation. University of Nebraska-Lincoln]. Retrieved at: http://dwb4.unl.edu/dwb/Research/MB/MasonBruning.html

McKeachie, W. J. (1995). Learning styles can become learning strategies. *The National Teaching & Learning Forum, 4*(6). DOI: 10.1002/ntlf.10024

McKeachie, W. J. (2005). Foreword. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.). *Handbook of Self-Regulation* (pp. xxi-xxiii). Burlington, MA, USA: Elsevier Academic Press.

McKenney, S., & Reeves, T. (2012). *Conducting Educational Design Research*. London: Routledge.

McLuhan, M. (1964). Understanding Media: The Extension of Man. New York: The New American Library.

Menges, R. J., & Austin, A. E. (2001). Teaching in higher education. In V. Richardson (Ed.), *Handbook of Research on Teaching,* 4th ed. (pp. 1122-1156). Washington, DC: American Educational Research Association.

Merrill, M. D. (1994). *Instructional Design Theory*. Englewood Cliffs, NJ: Educational Technology Publications.

Merrill, M. D., Drake, L., Lacy, M. J., Pratt, J., & ID2 Research Group (1996). Reclaiming instructional design. *Educational Technology, 36*(5), 5-7. Retrieved at: http://mdavidmerrill.com/Papers/Reclaiming.PDF

Michinov, N., Brunot, S., Le Bohec, O., Juhel, J., & Delaval, M. (2011). Procrastination, participation, and performance in online learning environments. *Computers & Education, 56*(1), 243-252. doi:10.1016/j.compedu.2010.07.025

Miller, R. B., & Brickman, S. J. (2004). A model of future-oriented motivation and self-regulation. *Educational Psychology Review, 6*(1), 9-33. Doi: 10.1023/B:EDPR.0000012343.96370.39

Molander, J. (2003). Vetenskapsteoretiska grunder: Historia och begrepp. Lund: Studentlitteratur.

Moore, M. (2009). *Do we need to move from instructional design to experience design?* [online discussion, LinkedIn, The eLearning Guild's discussion forum, December 30th 2009]. Retrieved at: http://www.linkedin.com/groupAnswers?viewQuestionAndAnswers=&gid=102144&discussionID=11556616&sik=1263385447719&trk=ug_qa_q&goback=.ana_102144_1263385447719_3_1

Mor, Y. (2011). *A design approach to research in technology enhanced mathematics education* [Dissertation online]. Institute of Education, University of London. Retrieved at: http://www.yishaymor.org/phd

Murphy, P. K., & Holleran, T. A. (2004). Do virtual environments lead to virtual learning? In A. Peacock, & A. Cleghorn (Eds.), *Missing the Meaning: The Development and Use of Print and Non-Print Text Materials in Diverse School Settings*. New York: Palgrave MacMillan.

Nahl, D. (2004). Measuring the affective information environment of web searchers. In *Proceedings of the 67th ASIS&T Annual Meeting, 41* (pp. 191-197). Medford, NJ: Information Today.

Nahl, D. (2005). Affective load theory (ALT). In K E. Fisher, S. Erdelez, & E. F. McKechnie (Eds.), *Theories of Information Behavior: A Researcher's Guide* (pp. 39-43). Medford, NJ: Information Today Inc.

Nahl, D. (2012). Affective load and engagement in Second Life: Experiencing urgent, persistent, and long-term information needs. In M. Thomas, (Ed.), *Design Implementation, and Evaluation of Virutal Learning Environments* (pp. 168-183). Hershey, PA: IGI Global.

Nevgi, A. (2002). Measurement of learning strategies - creating a self-rating tool for students of the virtual university. In H. Niemi, & P. Ruohotie (Eds.), *Theoretical Understandings for Learning in the Virtual University* (pp. 207-231). Hämeenlinna, Finland: Research Centre for Vocational Education and Training.

Nicholls, J. G. (1978). The development of the concepts of effort and ability, perception of academic attainment, and the understanding that difficult tasks require more ability. *Child Development, 49,* 800-814.

Niemi, H. & Ruohotie, P. (Eds). (2002). *Theoretical Understandings for Learning in the Virtual University*. Saarijärvi, Finland: Saarijärven Offset Oy.

Niemi, H. (2002) Empowering learners in the virtual university. In H. Niemi & P. Ruohotie (Eds). *Theoretical Understandings for Learning in the Virtual University* (pp. 1-37). Saarijärvi, Finland: Saarijärven Offset Oy.

Nokelainen, P. (2006). An empirical assessment of pedagogical usability criteria for digital learning material with elementary school students. *Journal of Educational Technology & Society, 9*(2), 178-197.

Norman, D. (2003). *Emotional Design: Why We Love (or Hate) Everyday Things*. New York: Basic Books.

Nyström, M. (2007). *Hermeneutik.* [web site]. 3.2.2007. Retrieved at: http://infovoice.se/fou/bok/kvalmet/10000012.htm

Oatley, K., Parrott, W.G., Smith, C., & Watts, F. (2011). Cognition and emotion over twenty-five years. *Cognition and Emotion*, *25,* 1341-1348. Retrieved at: http://www.tandfonline.com/doi/pdf/10.1080/02699931.2011.622949

Olgren, C. H. (1996). Cognitive strategies in independent learning. In C. C. Gibson (Ed.), *Distance Education Symposium 3: Learners and Learning*. ACSDE Research Monograph 13 (pp. 4-16). University Park, PA: The Pennsylvania State University, American Center for the Study of Distance Education.

Olgren, C. H. (2000). Learning strategies for learning technologies. In E. J. Burge (Ed.), *The Strategic use of learning technologies* (pp. 7-16). SF, CA: Jossey-Bass, A Wiley Company.

Persaud, N., & Eliot, M. (2014). The development and refinement of student self-regulatory strategies in online learning environments. In M. Horsley, N. Toon, B. Knight, & R. Reilly (Eds.), *Current Trends in Eye Tracking Research* (pp. 317-336). Springer-Verlag.

Peters, D. (2013). *Interface design for learning: Design strategies for learning experiences.* San Francisco: New Riders.

Petta, P., Pelachaud, C., & Cowie, R. (Eds.) (2011). *Emotion-Oriented Systems: The Humaine Handbook.* Heidelberg: Springer-Verlag.

Piaget, J. (1977). The development of thought: Equilibration of cognitive structures. New York: The Viking Press. (Originally published in French, 1975).

Pintrich, P. (2000). The role of motivation in self-regulated learning. In P. Pintrich & P. Ruohotie (Eds.), *Conative constructs and self-regulated learning.* Saarijärvi, Finland: Saarijärven Offset Oy.

Pintrich, P. (2005). The role of goal-orientation in self-regulated learning. In M. Boekaerts, Pintrich, P. R., & M. Zeidner (Eds.). *Handbook of Self-Regulation* (pp. 452-502). Burlington, MA, USA: Elsevier Academic Press.

Pintrich, P. R. (1989). The dynamic interplay of student motivation and cognition in the college classroom. In C. Ames, & M. Maehr (Eds.), *Advances in motivation and achievement: Vol. 6. Motivation enhancing environments* (pp. 117-160). Greenwich, CT: JAI Press.

Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. Journal of *Educational Psychology, 95*(4), 667-686. Doi: 10.1037/0022-0663.95.4.667

Pintrich, P. R., & McKeachie, W. J. (2000). A framework for conceptualizing student motivation and self-regulated learning in the college classroom. In P. R. Pintrich, & P. Ruohotie (Eds.), *Conative constructs and self-regulated learning* (pp. 31-50). Saarijärvi, Finland, Saarijärven Offset Oy.

Pintrich, P. R., Smith, D., Garcia, T., & McKeachie, W. J. (1991). *A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ).* Ann Arbor: University of Michigan, National Center for Research to Improve Postsecondary Teaching and Learning.

Pintrich, P. R., Wolters, C. A., & Baxter, G. P. (2000). Assessing metacognition and self-regulated learning. In G. Schraw, & J. C. Impara (Eds.), *Issues in the Measurement of Metacognition* (pp. 43–97). Lincoln, NE: University of Nebraska Press.

Plutchik, R. (1980). *Emotion: Theory, research, and experience: Vol. 1. Theories of emotion 1.* New York: Academic

Poh, M. Z., Swenson, N. C., & Picard, R. W. (2010). A wearable sensor for unobtrusive, long-term assessment of electrodermal activity. *IEEE Transactions on Biomedical Engineering, 57*(5), 1243-1252.

Pressley, M., Borkowski, J. G., & Schneider, W. (1987). Cognitive strategies: Good strategy users coordinate metacognition and knowledge. In R. Vasta, & G. Whitehurst (Eds.), *Annals of Child Development* (Vol. 5, pp. 89-129). New York: JAL.

Puustinen, M. & Pulkkinen, L. (2001). Models of Self-regulated Learning: A review. *Scandinavian Journal of Educational Research, 45*(3), 269-286(18). DOI: http://dx.doi.org/10.1080/00313830120074206

Quesenbery, W. (2001). What does usability mean: Looking beyond 'ease of use'. *Proceedings of the 48th Annual Conference, Society for Technical Communication*, Chicago, Illinois, 13-16 May. Retrieved at: http://www.wqusability.com/articles/more-than-ease-of-use.html

Randi, J., & Corno, L. (2005). Teaching and learner variation. In P. Tomlinson, & P. Winne (Eds.), *Pedagogy: Teaching for learning. Monograph series II: Psychological aspects of education* (No. 3, pp. 47–69). Leicester, England: British Psychological Society.

Reed, T., & Francis, L. M. (2001). Build skill with a-learning [online text on the ASTD Learning Circuits website]. Retrieved at: http://www.learningcircuits.org/2001/oct2001/francis.html

Reichertz, J. (2004). Abduction, deduction and induction in qualitative research. In U. Flick, E. von Kardoff, I. Steinke (Eds.), *A Companion to Qualitative Research* (pp. 159-165). Glasgow, UK: SAGE Publications Ltd.

Reigeluth, C. M. (1999). What is instructional design theory and how is it changing? In C. M. Reigeluth (Ed.), *Instructional-Design Theories and Models: A New Paradigm of Instructional Theory, Volume II* (pp. 5-30). Mahwah, NJ: Lawrence Erlbaum Associates.

Reigeluth, C. M., & Frick, T. W. (1999). Formative research: A methodology for creating and improving design theories. In C. M. Reigeluth (Ed.), *Instructional-Design Theories and Models: A New Paradigm of Instructional Theory, Volume II* (pp. 633-651). Mahwah, NJ: Lawrence Erlbaum Associates.

Reitano, P. (2006). The value of video stimulated recall in reflective teaching practices. *Proc. of ACSPRI Social Science Methodology Conference*, University of Sydney, 10-13 December. Retrieved at: http://www.acspri.org.au/conference2006//proceedings/streams/Retino_Paul_Full%20Paper.pdf

Repstad, P. (1993). *Närhet och distans: kvalitativa metoder i samhällsvetenskap*. Lund: Studentlitteratur AB.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning, *Educational Psychologist, 38*(1), 43-52. DOI: 10.1207/S15326985EP3801_6

Richardson, J. T. E. (2000). *Researching student learning: Approaches to studying in campus-based and distance education.* Buckingham: Open University Press.

Richardson, J. T. E., Morgan, A., & Woodley, A. (1999). Approaches to studying in distance education, *Higher Education, 37,* 23-55.

Riding & Rayner, (1998). *Cognitive styles and learning strategies: Understanding style differences in learning behaviour.* London: David Fulton Publishers.

Ritchie, D. C., & Hoffman, B. (1997). Incorporating instructional design principles with the World Wide Web. In B. H. Khan (Ed.), *Web-based instruction* (pp. 135-138). New Jersey: Educational Technology Publications.

Rohrkemper, M. M. (1989). Self-regulated learning and academic achievement: A Vygotskian view. In B. J. Zimmerman, & D. H. Schunk (Eds.), *Self-regulated Learning and Academic Achievement: Theory, Research, and Practice* (pp. 143-167). New York: Springer-Verlag.

Ruohotie, P. (2000). Conative constructs in learning. In P. R. Pintrich, & P. Ruohotie (Eds.), *Conative constructs and self-regulated learning* (pp. 1-30). Saarijärvi, Finland, Saarijärven Offset Oy.

Ruohotie, P. (2002). Motivation and self-regulation in learning. In H. Niemi, & P. Ruohotie (Eds.), *Theoretical Understandings for Learning in the Virtual University*. Saarijärven Offset Oy, Saarijärvi, Finland.

Saunders, N. G. (1998). Learning strategies for coping with computer technology in a distance learning environment. *Annual Meeting of the Mid-Western Educational Research Association,* Chicaco, Illinois.

Schönberger, K. (2006). Using ICT and socio-cultural change: persistent and recombinant practices in using weblogs. In F. Dudweeks, F. Hrachovec, & C. Ess (Eds.), *Proceedings of the Fifth International Conference on Cultural Attitudes towards Technology and Communication.* Tartu, Estonia, 28 June – 1 July.

Schunk, D. H. (1989). Social cognitive theory and self-regulated learning. In B. J. Zimmerman, & D. H. Schunk (Eds.), *Self-Regulated Learning and Academic Achievement: Theory, Research, and Practice* (pp. 83-110). New York: Springer-Verlag.

Selander, S. (2008). Designs for learning: A theoretical perspective. *Designs for Learning, 1*(1), 9-22.

Selander, S., & Kress, G. R. (2010). *Design för lärande: ett multimodalt perspektiv*. Stockholm: Norstedts.

Shea, P. (2011). Learning presence in the community of inquiry model: Towards a theory of online learner self- and co-regulation. In T. Bastiaens, & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications, EdMedia 2011* (pp. 2556-2565). Chesapeake, VA: AACE.

Shneiderman, B. (1982). The future of interactive systems and the emergence of direct manipulation. *Behaviour & Information Technology, 1*(3), 237–256.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3-10.

Siemens, G. (2010). TEDxNYED presents George Siemens - 03/06/10. (Online video). Retrieved at: https://www.youtube.com/watch?v=4BH-uLO6ovI&list=PLCFDAD8AC0B8D1680

Sims-Knight, J. E., & Upchurch, R. L. (2001). What is wrong with giving students feedback? *Proceedings of the 2001 American Society for Engineering Education Annual Conference & Exposition.* Retrieved at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.86.8301&rep=rep1&type=pdf

Smeck, R. R. (Ed.) (1988). *Learning strategies and learning styles: Perspectives on individual differences*. New York: Plenum Press.

Smith, P. J. (2000). *Developing Strategies for Effective Workplace Use of Flexible Delivery for Training* [paper online] University of South Australia. Retrieved at: http://www.unisanet.unisa.edu.au/cccc/papers/refereed/paper47/Paper47-1.htm

Snow, R. E., Corno, L. & Jackson III. D. N. (1996). Individual differences in affective and conative functions. In D. C. Berliner, & R. C. Calfee (Eds.), *Handbook of Psychology* (pp. 243–310). New York: Macmillan.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. M. Duffy, & D. H. Jonassen (Eds.), *Constructivism and the Technology of Instruction: A Conversation* (pp. 57-76). Hillsdale, NJ: Lawrence Erlbaum Associates.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences* (pp. 409-426). Cambridge, UK: Cambridge University Press.

Stewart, T. (2008). *Usability or User Experience - What's the difference?* [web site by System Concepts: Humanising Work and Technology]. Retrieved at: http://www.system-concepts.com/articles/usability-articles/2008/usability-or-user-experience-whats-the-difference.html

Susimetsä, M. (2006). *Motivated and self-regulated learning of adult learners in a collective online environment.* Dissertation. Tampere University, Tampere, Finland.

Säljö, R. (2000). *Lärande i praktiken: Ett sociokulturellt perspektiv* [Learning in practice: A sociocultural perspective]. Stockholm: Prisma.

Säljö, R. (2002). Lärande i det 21:a århundradet [Learning in the 21st century]. In R. Säljö & J. Linderoth (Eds.), *Utm@ningar och e-frestelser: it och skolans lärkultur* [Ch@llenges and e-temptations: ICT and the learning culture of our school]. Stockholm: Prisma.

Tennyson, R. D. (2010). Historical reflection on learning theories and instructional design. *Contemporary Educational Technology*, *1*(1), 1-16.

Tessmer, M. & Jonassen, D. (1988). Learning strategies: a new instructional technology. In D. Harris (Ed.), *World Yearbook of Education 1988: Education for the New Technologies* (pp. 17-31). London: Kogan Page.

Tobii Technology AB (2009). *Retrospective think aloud and eye tracking.* [Whitepaper online]. Retrieved at: http://www.tobii.com/Global/Analysis/Training/WhitePapers/Tobii_RTA_and_EyeTracking_WhitePaper.pdf

Tobii Technology AB (2010). *Tobii Eye Tracking: An introduction to eye tracking and Tobii Eye Trackers.* [Whitepaper online]. Retrieved at: http://www.tobii.com/Global/Analysis/Training/WhitePapers/Tobii_EyeTracking_Introduction_WhitePaper.pdf

Tobin, D. R. (2000). *All Learning is Self-Directed: How Organizations Can Support and Encourage Independent Learning.* USA: ASTD.

Thomson, P., & Kamler, B. (2013). *Writing for Peer Reviewed Journals. Strategies for getting published.* London: Routledge.

Tolboom, J. L. J. (2012). *The Potential of a Classroom Network to Support Teacher Feedback: A Study in Statistics Education.* Dissertation. University of Groningen. The Netherlands.

Tsai, M.-J. (2009). The model of strategic e-learning: understanding and evaluating student e-learning from metacognitive perspectives. *Educational Technology & Society, 12*(1), 34-48.

Turner, J. C. (2001). Using context to enrich and challenge our understanding of motivational theory. In S. Volet, & S. Järvelä (Eds.). *Motivation in learning contexts: Theoretical advances and methodological implications.* Oxford: Pergamon.

Turner, J., & Paris, S. G. (1995). How literacy tasks influence children's motivation for literacy. *The Reading Teacher, 48*(8), 662-673.

Van den Haak, M. J., de Jong, M. D. T., & Schellens, J. (2003). Retrospective vs. Concurrent think-aloud protocols: testing the usability of an online library catalogue. *Behavior & Information Technology, 22*(5), 339-351.

VanderStoep, S., & Pintrich, P. R. (2003). *Learning to learn: The skill and will of college success.* Upper Saddle River, NJ: Merrill Prentice-Hall.

Vickers J. (2012). The Problem of Induction. *The Stanford Encyclopaedia of Philosophy.* Retrieved at: http://plato.stanford.edu/entries/induction-problem/

Vohs, K. D., & Baumeister, R.F. (2004). Understanding self-regulation: An introduction. In R. F. Baumeister, & K. D. Vohs (Eds.), *Handbook of Self-Regulation: Research, Theory, and Applications* (pp. 1-9). New York: Guilford.

Volet, S. (2001). Emerging trends in recent research on motivation in learning contexts. In S. Volet, & S. Järvelä (Eds.), *Motivation in Learning Contexts: Theoretical Advances and Methodological Implications.* Oxford: Pergamon.

Vygotsky, L. (1978). *Mind in Society. The Development of Higher Psychological Processes.* Cambridge, MA: Harvard University Press. (Original texts published 1930–1935).

Wang, S. & Han, S. (2001). Six C's of Motivation [online book chapter]. In M. Orey (Ed.), *Emerging Perspectives on Learning, Teaching, and Technology.* Retrieved at: http://projects.coe.uga.edu/epltt/

Weinstein, C. E. (1994). Strategic learning/strategic teaching: Flip sides of a coin. In P. R. Pintrich, D. R. Brown, & C. E. Weinstein (Eds.), *Student Motivation, Cognition, and Learning: Essays in Honor of Wilbert J. McKeachie* (pp. 257-273). Hillsdale, NJ, Erlbaum.

Weinstein, C. E., Husman, J., & Dierking, D. R. (2005). Self-regulation interventions with a focus on learning strategies. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of Self-Regulation* (pp. 727-747). Burlington, MA, USA: Elsevier Academic Press.

Weinstein, C. E., Palmer, D. R., & Schulte, A. C. (1987). *Learning and Study Strategies Inventory.* Clearwater, FL: H&H Publishing.

Weinstein, C. F., & Meyer, D. K. (1991). Cognitive learning strategies. In R. J. Menges, & M. D. Svinicki (Eds.), *College Teaching: From Theory to Practice* (pp. 15-26). New Directions for Teaching and Learning, No. 45. San Francisco: Jossey-Bass.

Wiklund-Engblom, A. (2007). The web-based learning process: Facilitators for developing strategies for self-directed web-learning. *Proceedings of the 6th European Conference on e-Learning, ECEL*, 4-5 October, Copenhagen.

Wiklund-Engblom, A. (2008). The strategic e-learner: Variations of cognitive strategies and learning needs [online paper]. Proceedings of the *European Association for Research in*

Learning and Instruction (EARLI) SIG9 on Phenomenography and Variation Theory, 22-24 May, Kristianstad.

Wiklund-Engblom, A. (2009). Approaches and strategies for choice of actions in self-paced e-learning in the workplace. *International Journal of Advanced Corporate Learning (iJAC) 2*(1).

Wilson, B.B., & Myers, K. M. (2000). Situated cognition in theoretical and practical context. In D. Jonassen & S. Land (Eds.), *Theoretical Foundations of Learning Environments* (pp. 57–88). Mahway, NJ: Lawrence Erlbaum Associates.

Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated engagement in learning. In D. Hacker, J. Dunlosky & A. Graesser (Eds.), *Metacognition in Educational Theory and Practice* (pp. 277-304). Hillsdale, NJ: Lawrence Erlbaum.

Winne, P. H. (2010). Improving measurement of self-regulated learning. *Educational Psychologist, 45*(4), pp. 267-276.

Winne, P. H., & Perry, N. E. (2005). Measuring self-regulated learning. In P. Pintrich, M. Boekaerts, & M. Seidner (Eds.), *Handbook of Self-Regulation* (pp. 531-566). Orlando, FL: Academic Press.

Yecan, E., Cagiltay, K. (2006). Cognitive styles and students' interaction with an instructional web-site: tracing users through eye-gaze. *Proceedings of the 6th International Conference on Advanced Learning Technologies (ICALT '06).* IEEE Computer Society.

Yin, R. K. (2003). *Case study research, design and methods*, 3rd ed. Newbury Park: Sage Publications.

Yost, D. (2007). *CertMag's Guide to e-Learning* [online article] Retrieved at: http://www.certmag.com/issues/aug02/feature_yost.cfm

Zariski, A. & Styles, I. (2000). Enhancing student strategies for online learning. In A. Herrmann and M. M. Kulski (Eds.), *Flexible Futures in Tertiary Teaching.* Proceedings of the 9th Annual Teaching Learning Forum, 2-4 February 2000. Perth: Curtin University of Technology. Retrieved at: http://lsn.curtin.edu.au/tlf/tlf2000/zariski.html

Zeidner, M., Boekaerts, M., & Pintrich, P. R. (Eds.) (2005). Self-regulation: Directions and challenges for future research. In M. Boekaerts, P. R. Pintrich, & M. Zeidner, (Eds.), *Handbook of Self-Regulation* (2nd ed. pp. 750-768). San Diego, CA: Academic Press.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*(3), 329-339.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25*, 3-17.

Zimmerman, B. J. (1994). Dimensions of academic self-regulation: A conceptual framework for education. In D. H. Schunk, & B. J. Zimmerman (Eds.), *Self-Regulation of Learning and Performance: Issues and Educational.* Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.

Zimmerman, B. J. (2005). Attaining self-regulation: a social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of Self-Regulation* (pp. 13-41). Burlington, MA, USA: Elsevier Academic Press.

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23,* 614-628.

Zimmerman, B. J., & Martinez-Pons, M. (1988). Construct validation of a strategy model of student self-regulated learning. *Journal of Educational Psychology, 80,* 284-290.

Appendices

Appendix 1. Strategic Flexibility Questionnaire[39]

This questionnaire contains statements about how you go about the various tasks you are given in your studies.

There are no right or wrong responses to the items in this questionnaire. How you respond depends upon your own individual method of learning. No two people would be expected to give the same response to each item.

If you think the statement is nearly always true of you, then circle A5", if you think the statement is almost never true of you, then circle A1". If you fall somewhere in between, circle A2", A3" or A4".
Think about learning in your history classes while answering the questions

Answer every item, and do not spend too long on each item.

[Likert scale: *Never true of me*   1 - 2 - 3 - 4 - 5 *Always true of me*]

1. I find that I have one good way of going about completing my assignments, and this is effective nearly all the time

2. I often find the ideas and methods I come across when preparing for an assignment more confusing than helpful

3. I place a lot of importance on adjusting my study methods to meet the requirements of particular tasks

4. While I know that different study tasks sometimes require different approaches, I am usually happier to stick to tried and trusted methods

5. Although the assignment I am working on may require me to use several different ways of working, I usually end up sticking to my normal methods

6. Before starting work on a particular problem I like to play with a number of possible ways of attacking the problem

7. While I usually feel quite confident that I understand how to go about completing an assignment, I often find it hard to fit the material I am using into my assignment plan

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[39] Questionnaire adapted from Cantwell and Moore (1996).

8. I often feel that the hardest part of doing assignments is knowing how to do them rather than knowing what to do

9. I find it challenging when the problem or assignment I have been given requires me to find different ways of studying

10. While I usually like to focus on the main ideas and details of a topic I am studying, I also like to explore different ways of putting this material together before I write up my assignment

11. Once I have found a satisfying way of approaching my study, I feel it is safest to stick with this method

12. I prefer to follow my usual methods of studying, even if this isn't exactly what the assignment requires

13. I rarely change the way I study, regardless of particular topic requirements

14. I often find the most interesting part of an assignment is in discovering new ways of tying my material together, and this often leads me to change the way I go about completing the task

15. I often find I use the same way of working no matter what the particular unit of work is that I am studying

16. Although I usually understand the information I should include in my assignments, I often have difficulty deciding where and when I should use that information

17. While I usually feel confident about my purpose in completing an assignment, I often lose direction when dealing with detailed information, and find myself uncertain of how to deal with this

18. I often look forward to discovering new or different ways of completing problems or assignments I have been given

19. I believe that every problem I am given has a particular way of being completed, and I adjust my way of attacking it accordingly

20. Although I often know the general ideas relating to a topic, I often get caught out when asked for details, and I'm never sure how to overcome this

21. I find I am easily distracted from my line of thought as I am working, and this often makes my work disjointed and uneven

Appendix 2. Reflecting on E-learning Strategies Questionnaire[40]

RESQUE – Reflecting on E-learning Strategies Questionnaire
Pilot study for e-learning development

The first section is your self-assessment.
Choose the number between 1 and 6 that you feel suits you best
(1= Very little . . . . 6= A lot)

I. SELF-ASSESSMENT
Please, assess ...
[Very little . . 1 2 3 4 5 6 . . A lot]
1. .... the prior knowledge you had of the course content.
2. .... the prior experience you had of self-paced e-learning courses.
3. .... how comfortable you felt about taking this course as an e-learning solution.
4. .... how motivated you were to take this course.
5. ... how well you learned the content (according to course objectives).
6. ... how satisfied you are with the level of knowledge you gained from the course.
7. ... how well you would be able to apply this new knowledge in real-life situations.
8. ... how much use you will have of this course content in your daily work.
9. ... how much effort you put into this course.
Additional comments:

Decide how well you agree or disagree with the statements below.
Choose the number between 1 and 6 that you feel suits you best
(1= Disagree . . . . 6= Agree)

II. YOUR MOTIVATION FOR E-LEARNING
[Disagree . . 1 2 3 4 5 6 . . Agree]
10. I feel that I would have learned the material better in a traditional training course.
11. I had a feeling of not being able to technically manage the course environment.
12. I got frustrated with the e-learning environment/layout of this course.
13. I felt engaged and activated by this course.
14. I felt that I was guided and supported in knowing how to learn within this course environment.
Additional comments:

II. YOUR E-LEARNING STRATEGIES
[Disagree . . 1 2 3 4 5 6 . . Agree]
 (A) E-Learning Context Approach
15. I approached the course environment by trying things out on my own without bothering to read any instructions.

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[40] Adapted and reworked from MSLQ (Pintrich et al., 199) and LASSI (Weinstein et al., 1987)

16. Before I began the course, I surfed through the e-learning environment so that I knew how everything worked.
17. The introductory instructions about the course were useful to me.
Additional comments:

(B) Interaction & Feedback for Reflection
18. I felt uninvolved and inactive while reading the information presented.
19. I would have liked more ways of interacting with the course material (e.g., tasks).
20. I would have liked more interaction with other trainees/course participants.
21. I would have liked to have interacted with a live teacher/instructor while taking the course.
22. I would have liked more feedback on my actions in the course environment.
Additional comments:

(C) Self-Paced Effort Regulation
23. Even when I found the content dull and uninteresting, I managed to keep working until I was finished.
24. If it had not been for the testing situation, I would not have taken all the parts of the course.
Additional comments:

(D) Concentration
25. Problems at work/at home caused me to lose my concentration.
26. I found it hard to pay attention to the course material.
27. I found it more difficult to concentrate on this e-learning course, than in a traditional (hands-on) training course.
Additional comments:

(E) Identifying Important Information
28. I began by first trying to locate and view the most important information in each section.
29. I had difficulty dealing with the large amount of information in some of the sections.
30. I had difficulty identifying key points in the course material.
Additional comments:

(F) Study Aids & Organisation
31. I wrote down notes and comments as I went through the course material.
32. I made drawings or sketches to help me understand the information.
33. I made simple charts, diagrams, or tables to summarize the information.
34. I made an outline of the most important information in order to help me organise my thoughts.
Additional comments:

(G) Elaboration
35. I wrote brief summaries of the main ideas from the information.
36. I tried to translate the information into my own words, in order to understand it better.
37. I tried to relate the information to my own work tasks.
Additional comments:

(h) Critical Thinking

38. When a theory, interpretation, or conclusion was presented, I tried to decide if there was enough supporting evidence.

39. I treated the information presented as a starting point and tried to develop my own ideas about it.

Additional comments:

(I) Rehearsal & Memorisation

40. I repeated various parts of the course several times to make sure I understood everything.

41. I memorised key words to remind me of important concepts in the course material.

Additional comments:

(J) Metacognitive Self-Regulation

42. I set goals for myself in order to direct my activities in the course work.

43. I had difficulty adapting my way of learning to this kind of course environment.

44. If the information was difficult to understand, I chose another presentation of the same material.

45. I stopped periodically while going through the material and mentally went over what was presented.

46. When I became confused about something, I went back and tried to figure it out.

47. After each section, I reviewed my notes to help me understand the information.

48. While listening/reading the material, I checked to see if I understood what the content was all about.

49. When going through the material, I tried to determine which concepts/facts I didn't understand well.

50. I tried to think through a topic and decide what I was supposed to learn from it, rather than just passively going through the material.

Additional comments:

IV. USING RESOURCE OPTIONS

Rate an option according to how it helped you learn
   - - - *Please leave line empty if you never used a specific option*

The resource option helped me learn ...
[Very little . . 1   2   3   4   5   6 . . A lot]

R1. searching web pages outside the course for additional data related to the topics (e.g., by using search engines & Internet)

R2. printing text documents, so that you could make comments and underline important sections

R3. printing text documents, simply to avoid reading it on the screen

R4. printing documents for later reference

R5. practicing your knowledge with multiple choice questions

R6. writing down comments on paper

R7. other features of the course (give own example):

Name other ways you chose to use resources, in order to learn:

Rate how the following options helped you learn:

[Very little . . 1 2 3 4 5 6 . . A lot]

R8.   Static text
R9.   Scrolldown text
R10.   Text with hyperlinks
R11.   Static (real life) photos
R12.   Animated (real life) photos with automatic zoom on details
R13.   Links to enlarged images with text
R14.   Links to enlarged images with headings
R15.   Links to enlarged images with arrows
R16.   Static arrows
R17.   Animated arrows
R18.   Photo collection (several photos on one screen)
R19.   Photo collection plus drawings/illustrations
R20.   Drawings
R21.   Diagrams
R22.   Mouse-over links showing red frames around images
R23.   Mouse-over images showing red frames around images
R24.   Links to pdf-files

V. YOUR FEEDBACK

F1. How did you feel about taking this e-learning course?

F2. How would you improve this course?

F3. What kind of problems (if any) did you have while navigating (finding your way) in the course environment?

F4. What kind of help did you need/would you have needed while studying this course?

VI. BACKGROUND INFORMATION

B1. How much time (in minutes) did you spend on this course?

B2. What was your performance score in the final test?

B3. Your reasons for taking this course:

B4. How many self-paced e-learning courses have you taken prior to this?

B5. Your work title:

B6. Your level of education:

B7. Nationality/ethnic background:

B8. Gender:

B9. Year of birth:

Comments about the RESQUE-form:

Please, write your e-mail address.

Thank you for participating!

Annika Wiklund-Engblom

Designing New Learning Experiences?

Exploring Corporate E-Learners' Self-Regulated Learning

How can we design digital learning contexts to support self-regulated learning (SRL)? A self-regulated e-learner is able to exercise agency and cope with new digital learning contexts, despite the fact that these often lack the feedback processes inherent in traditional face-to-face interactions. This study has explored how the design of an e-learning course influenced actions and intentions of corporate e-learners with regard to their self-regulation of behaviour, cognition, and affect. Results show that feedback facilitated self-regulation and targeted exploration. Important needs of the corporate e-learners were real life relevance of content, flexible assessment, and options for social meaning negotiation. SRL was found to be dynamically interconnected with an affect-cognition continuum of both positive and negative experiences *(Learning experience dimension)*. Awareness of self-regulation in relation to learning in a digital context was identified as design-based epistemic metareflection (SRL agency dimension). Results suggest that learning designs can empower e-learners by supporting their design-based epistemic metareflection in relation to affordances and constraints of the learning technology design *(Content and context dimension)* .

Annika Wiklund-Engblom | Designing New Learning Experiences? | 2015