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Christian Östlund

DESIGN FOR E-TRAINING

Doctoral School of Business and Management

PhD Series 18.2017

CBS  COPENHAGEN BUSINESS SCHOOL
HANDELSHØJSKOLEN

Design for e-training

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Abstract:

This thesis is about designing technology that supports and enhances learning in and for the workplace. This is realized through an e-training system of web lectures. Designing e-training means designing for interaction in a user friendly way while accommodating for the pedagogical and instructional strategies that are inherent in learning systems. The objective of this thesis is to inform how technology can be designed to support workplace training by acknowledging the context demands of every day work. The context for this thesis is the government authority in Sweden called the county administration. The research in this thesis follows the approach of design science research and design principles for e-training through web lectures emerged in collaboration with members of the county administration through four design cycles of problem awareness: conceptual suggestion, system development, and evaluation.

The perspective on learning adopts that of socio-cultural learning since it acknowledges the importance of context by stressing the relationship between learning and the context in which the learning occurs. A framework called authentic e-learning with nine core design principles was chosen as a kernel theory. The first version of the web lecture application was based on the unchanged design principles of authentic e-learning. The design principles were then evaluated in the context of a work place and after four design cycles some of the original design principles was still unaltered, some was adapted to the conditions of work place learning and new principles emerged from the evaluation process. The thesis concludes with eight design principles for e-training through web lectures.

Sammanfattning:

Denna avhandling handlar om att designa teknologi för stödja och förbättra arbetsintegrerat lärande genom ett informationssystem för webbföreläsningar. Att designa arbetsintegrerat lärande innebär att designa för interaktion på ett användarvänligt sätt som samtidigt tar hänsyn till de pedagogiska aspekterna och strategier för lärande. Det övergripande målet för avhandlingen är att belysa hur teknologi kan designas så att den stödjer formellt arbetsintegrerat lärande genom att ta hänsyn till det dagliga arbetets villkor. Studien som ligger till grund för avhandlingen gjordes på Länsstyrelsen. Forskningsansatsen är design science research och en designteori för kompetensutvecklande e-träning via webbföreläsningar har växt fram ur ett samarbete med anställda på Länsstyrelsen genom fyra design cykler med faserna probleminidentifikation, konceptuell design, utveckling och utvärdering.

Avhandlingen genomsyras av en socio-kulturell syn på lärande eftersom detta synsätt betonar vikten av lärandet och kontexten lärandet sker i. Ett ramverk för autentiskt e-lärande med nio principer för design valdes som kärnteori. Den första versionen av webbföreläsningssystemet baserades på denna kärnteori. Därefter utvärderades hur dessa principer stod upp mot arbetets villkor i fyra designcykler. Utvärderingen gjorde gällande att några designprinciper inte behövde ändras, några anpassades efter arbetets villkor och nya principer växte fram ur utvärderingsprocessen. Avhandlingen avslutas med åtta designprinciper för e-träning genom webbföreläsningar.

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1 Introduction

Developing the competence of a workforce has always been a challenge for organizations, regardless if an organization is producing cars or providing healthcare or education. In the transition from the industrial era to an information society, with a more knowledge-based economy, human resources in terms of employees' competencies are becoming an increasingly important issue (Appelbaum and Gallagher, 2000; Browell, 2000; Teräs et al., 2012). An organization's core competencies have a strong impact on the competitive advantage and affect how well an organization performs (Agha et al., 2011), while the competencies of today's workforce at the same time are constantly challenged by digitalization and robotization (Sørensen, 2016).

At the same time the dynamic and rapidly changing nature of this transition creates the need for knowledge workers to integrate continuous learning with the tasks of everyday work (Tynjälä, 2008). This generates a potential paradox of having to constantly increase your competence as an employee, while the work situation does not allow for this (Folkman, 2002; Magnusson et al., 2000). The challenge for organizations then becomes to enable employees to engage in learning activities that improve their competence while not interfering with everyday work. Finally, there is a financial aspect that cannot be overlooked. Sending an employee away on a course or giving them time off for competence development is always connected with costs for the organization.

Many organizations view IT as a well-suited platform for developing tools and systems to meet this challenge (see e.g. Chuang et al., 2008; Jones, 2016). For example, a study made in the U.S. showed that 15 percent of all training is delivered

through IT, while at the same time traditional classroom training has dropped from 70 percent to 62 percent (Kakoty et al., 2011). In these learning environments, the learning activities are mediated through IT. The learners interact with learning materials, peers, and/or instructors through advanced information technologies (Alavi and Leidner, 2001). This provides the learners with a flexible learning environment that eliminates time and space barriers. Moreover, IT has the potential of lowering the costs of competence development by using and reusing material with a low cost of reproducing the digital learning material. This perceived efficacy combined with organizational readiness regarding IT knowledge and infrastructure and pressure from competitors are known driving forces behind organizations' adoption of IT in training (Chan and Ngai, 2007).

The concept of learning and training supported by IT is at the core of this research. Learning supported by IT is often framed as e-learning, and training supported by IT is often referred to as e-training. E-learning is the broader concept of the two and e-training is seen as a sub-set of e-learning. The goal of e-training is to support training and learning through IT in a work context. Learning is commonly (see Merriam-Webster Online Dictionary, 2016) considered as the process of acquiring knowledge or skills by studying, practicing, experiencing or being taught something, while training is the actual process by which someone is taught the skills needed for a job or a profession. Some of the more common umbrella terms used in studies on learning and training supported by IT, aside from e-learning and e-training are: technology mediated learning (Alavi and Leidner, 2001; Gupta and Bostrom, 2009), lifelong learning (Edwards et al., 2006), end-user training (Bostrom et al., 1990), distance education (Svensson, 2002), Computer Supported Cooperative Learning (CSCL) (Stahl, 2002), workplace training (Bassanini et al., 2005), and workplace learning (Matthews, 1999).

Distance learning and distance education are more commonly carried out in learning communities through educational institutions (Simonson et al., 2011), whereas CSCL theories are applied both in school and workplace contexts and stress the importance of communities and collaboration in problem solving. E-learning, lifelong learning, and technology-mediated learning are broader in their definitions. Lifelong learning is concerned with the learning people engage in throughout their lives, both inside and outside of education and training institutions (Edwards et al., 2006). Technology-mediated learning is an IT supported environment where learners interact with each other, the instructor and/or the learning material (Alavi and Leidner, 2001).

E-learning as a concept is very broad and “is commonly taken to mean the use of computers and the Internet for learning” (Littlejohn and Pegler, 2007, p. 16). E-learning is electronic training or instruction delivered on a computer “that is designed to support individual learning or organizational performance goals.” (Clark and Mayer, 2007, p. 7). Although there are examples of e-learning initiatives being distributed via other media, the most common infrastructure for distribution of e-learning is the Internet, as stated by Littlejohn and Pegler (2007).

Although Clark and Mayer’s (2007) definition accounts for both individual learning and organizational performance goals, Matthews’ (1999) definition better frames the interrelation between individual learning and organizational goals. Matthews’ (1999, p. 19-20) defines workplace learning as “the process of reasoned learning towards desirable outcomes for the individual and the organization. These outcomes should foster the sustained development of both the individual and the organization, within the present and future context of organizational goals and individual career

development”. Gupta and Bostrom (2009, p. 687) frame training as a method for companies to “enhance the productivity of individuals and to communicate organizational goals to new personnel”, when stating that training is the one of the most common ways to engage individuals in workplace training.

Training can thus be defined as the “systematic acquisition of skills, rules, concepts, or attitudes that should result in improved performance of the trainee” (Steensma and Groeneveld, 2010, p. 319). Adapted from Steensma and Groeneveld (2010), e-training is here defined as: “The systematic acquisition of skills, rules, concepts, or attitudes that is facilitated by IT and organized in a way that enhance the productivity of both the individual learner and organization”. The development of these skills, rules, concepts, or attitudes can be both informal while working (Lundin, 2006; Orr, 1996) or formal (e.g. Nilsson and Engström, 2015) while attending courses or participating in a training program. Both informal and formal learning may or may not be supported by technology. Informal learning is predominantly unstructured, experiential, and non-institutional, whereas formal learning is more pre-planned, structured, and formalized (Marsick and Volpe, 1999).

Workplace training encompasses everything from learning how to operate the coffee machine, to logging on to the company intranet, to learning strategic management skills, or doing research for product development, and thus includes a multitude of skills and abilities that many modern-day employees need to master and constantly improve. When developing IT to support workplace learning it is important to not only focus on the design of the technology, but also consider the pedagogical design. For a successful implementation of IT support for training, the designer needs an understanding of the integrated nature of technology and

pedagogy (Kahiigi et al., 2008). This understanding requires knowledge in both human computer interaction and learning theories. Human computer interaction is concerned with creating user friendly systems (Rogers et al., 2011), and the basic question learning theories try to address is how we learn.

In the early 1990's some anthropologists (Lave and Wenger, 1991) expanded ideas and theories from the psychologist Vygotsky (1978) to form a new perspective on learning that highly emphasized the social and cultural context in which learning takes place. There are currently frameworks and theories of technology mediated learning rooted in socio-cultural theories e.g. Hardless, (2005), Herrington et al., (2010), and Säljö (2001), who stress the situatedness of learning and the importance of authenticity in the learning activities, i.e. training and learning activities should have real-world relevance and utility.

Although a great deal of learning takes place outside educational institutions, most research on learning focuses “on the institutionalized and structural arrangements of formally provided education and training, in particular schooling and higher education” (Edwards et al., 2006, p. 1). While the majority of research studies are from the academic sphere, there is an increasing interest in using technology to support learning activities within organizations and companies. Many organizations and companies, particularly large enterprises or corporations rather than small and medium-sized enterprises (Roy, 2012), see the potential e-training has to offer learning-on-demand opportunities to individual employees, while simultaneously reducing training time and costs (Zhang and Nunamaker, 2003).

When choosing e-training as an approach to competence development in the workplace, management needs to address the issue of developing the employees'

competencies through ICT in an efficient and effective way (Strother, 2002). One way of doing this is to use guidelines or frameworks for the design of e-training that considers the interaction between the design of the interface between the learner and the technology *and* the design of pedagogical and instructional strategies (Kahiigi et al., 2008). There are examples of studies investigating how IT can be designed for training and learning for the workplace (e.g. Moon et al., 2005; Teräs and Herrington, 2014), but in general the IS community has not been as active in testing the conceptual frameworks that have been developed (Arbaugh et al., 2009), and there is a lack of research on how to identify the challenges in designing IT for workplace learning in particular (Dubois and Long, 2012).

Although there is a growing interest in how IT can support training and learning in work situations (Gupta and Bostrom, 2009; Folkman, 2002), there is still a need for theoretical research to crystalize principles and guidelines that can guide instructional designers in building these systems in a sound way (Salas and Cannon-Bowers 2001). Research on e-training lags behind developments of learning tools and services provided by companies (Alavi and Leidner, 2001) and has failed to sufficiently recognize the values and underlying assumptions about knowledge that guide the design of the learning method (Gupta and Bostrom, 2009). Recognizing the epistemological perspective, e.g. the socio-cultural perspective on learning, will help evaluate how the system supports learning and the learners' actions from the right perspective (Gupta and Bostrom, 2009).

To this day, as shown by the literature review in this thesis, the research is still behind in this area, especially research that considers the interplay between technology and pedagogy when designing systems for workplace learning and training. The research gap presented in this introduction and further discussed in

chapter two in the context of the literature review and theoretical background description, points to a need for research about e-training. This is an area that needs to be expanded by further research, not only from the perspective of designing technological support, but by also including the pedagogical aspect of instructional design. The scope of what must be learned can affect what pedagogical aspects need to be stressed. This thesis foremost addresses the issues of employees being able to apply new knowledge to a relevant work situation. As a response to the identified lack of research this thesis addresses the following research question:

How can information technology be designed to support workplace training?

Lundin (2006) calls for more research on IT support for workplace learning that embraces the social and contextual aspects of learning as put forward by the socio-cultural perspective on learning (Säljö, 2001; Vygotsky, 1978). With respect to the specific nature of e-training, socio-cultural theories of learning are highly relevant for workplace e-training studies, since this tradition highlights the situated nature of learning and the close interrelation between learning and practice (Lave and Wenger, 1991; Wenger, 1998). Socio-cultural theories on learning and training constitute the primary theoretical lens for the work presented in this thesis. The framework of authentic e-learning as introduced by Herrington et al. (2010), which takes its point of departure in the socio-cultural and situated view of learning, is applied as the kernel theory for developing the web lecture application (WLA) and design principles for e-training.

The case organization for the studies that form the foundation for this thesis is the county administration of Western Götaland in Sweden. Since the county administration was interested in building a nationwide solution for delivering e-

training, the theoretical outcome of the thesis aims at being relevant, not only for academic research in information technology enhanced learning and information technology based and supported training in organizational settings, but also for practitioners engaging in e-training. For this purpose, the lens of design science as a problem-solving and design oriented approach is chosen. Design science offers the possibility to solve actual problems in organizations, while being based on a scholarly tradition and also contributing to the body of academic research (Hevner et al., 2004; Gregor and Jones, 2007; Vaishnavi and Kuechler, 2008; Sein et al., 2011). The research approach of design science will be thoroughly introduced and discussed in chapter five.

1.1 Chapter Overview

The thesis proceeds as follows. In the next chapter, the central theoretical concepts and a synthesis of related research are accounted for. The chapter following the related research and theoretical perspectives introduce the theoretical basis and present the three frameworks that informed the design of the e-training systems. In chapter four the case organization and structure is described. Chapter five presents the research design with data collection and analysis methods and describes the process of the literature reviews. The following chapters are the empirical part of the research, and in chapters six to nine, the four cycles of design science research that were conducted to address the research question are described and discussed. The thesis concludes with a set of design principles for e-training through web lectures, and its implications for researchers and practitioners who are engaged in how to design technology that supports workplace training.

2 Related research and theoretical perspectives

There are many views on learning, and learning theorists subscribe to different ideas of how we humans learn. The notion of knowledge and how it is created is the key issue in most of these views. Learning theories commonly distinguish between three learning traditions, the behavioristic view (focus on outside conditions), the cognitivist thinking (focus on the internal process), and the socio-cultural perspective (focus on the context). According to the cognitive development tradition, the development processes precede the learning process, and there is no reason to try and learn something that is beyond what can be learned within the stage you are in. As a reaction to this, Vygotsky (1978) presented a theory where individuals instead of being at one point in a development stage are in what Vygotsky (1978) called a zone of proximal development. The theories of Vygotsky (1978), that in later years have gained a lot of interest and is the foundation to the socio-cultural view on learning, are presented in the following section. The chapter then proceeds to present and elaborate the central theories, concepts and empirical studies within learning, training, work, and IT.

2.1 Socio-cultural learning

Vygotsky stresses the importance of context in learning activities and argues that internalization of higher psychological functions originates in the social environment and points to a series of transformations that precede internalization of events in the external world:

- An operation that initially represents an external activity is reconstructed and begins to occur internally
- An interpersonal (occurring between individuals) process is transformed into an intrapersonal one
- The transformation of an interpersonal process into an intrapersonal (occurring within the individual mind) one is the result of a long series of developmental events

This could e.g. be a child reaching for an object that he/she cannot reach, and then an adult hands the child the object. Eventually the child sees the connection between the failed attempt to reach an object and the adult's intervention where the adult gives the child the object. For the child, the reaching for an object will then represent a communicative action, resulting in the child pointing towards an object and expecting an adult to hand him/her the object. This process is initially interpersonal (adult gives the child what the child is pointing to) but then becomes an intrapersonal process in the child's mind as an individual.

The developmental process should be adapted to where the individual learner currently is in their development stage, not too easy without challenges e.g. solutions to posed problems up front and not too difficult so that the learning activity is beyond the learner's capabilities (Vygotsky, 1978). In order to identify the relation between this developmental process and learning capabilities two developmental levels need to be established:

- Actual developmental level
- Potential developmental level

Humans learn outside of school and even if they systematically learn mathematics in school, it is possible that they have come in contact with addition and subtraction

before they start school. The actual developmental stage is then what the child has learned before entering the school system. The developmental stage is checked by tests of varying difficulty and if two ten-year boys after such tests get results equivalent to the mental development of an eight-year-old, it can be argued that these boys have the same mental age (Vygotsky, 1978).

The boys in the above example can independently handle problems corresponding to an eight-year-old, but suppose they get help with the problem solving. A teacher could initiate the problem solving process and then let the two boys carry on giving them hints and leading questions along the way or show the solution and then have them do it over again. After the test, the result could indicate that one boy under these circumstances had a potential mental development of a nine-year-old and that the other boy had the potential mental development of a twelve-year-old. The difference between eight and nine years or eight and twelve years is what Vygotsky (1978) calls the Zone of Proximal Development (ZPD).

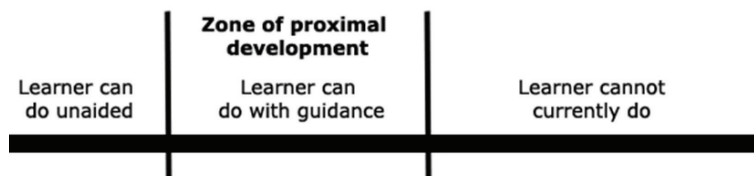


Figure 1. The Zone of Proximal Development (Vygotsky, 1978)

This zone covers a span stretching from the lowest level where the individual completely masters a skill to the upper level where the skills can only be mastered under optimal circumstances e.g. with assistance from someone who mastered these skills at a higher level. What is below the lower level is what we already know, and what has already been learned. Skills above the upper level are not yet achievable

even with the best of aid and are seen as a potential level of development. Everything between the lowest level and the highest level of development is the zone of proximal development. Initial help in doing something is eventually internalized as new knowledge. As the individual develops the ZPD moves as more skills are mastered and new skills come within reach under optimal circumstances, and one does not stop developing at a certain stage but rather keeps learning throughout life. How fast an individual learns and develops within the ZPD differs from person to person and also from domain to domain. The span of the ZPD is also individual and differs from domain to domain.

With ZPD all the environmental factors that play a role in how we learn and solve problems can be accounted for. How hard the problem solving or learning activity is, is influenced by factors such as for example, if all the facts related to a problem are clearly described/available or if the solving of a problem or learning a new skill is aided by instruction and cues from someone or something. With ZPD Vygotsky (1978) argued that learning should be tailored to where each learner is in his/her development. The task should not be too easy and without challenge, but not at a too difficult level either.

Vygotsky (1978) argued from a sociocultural viewpoint that learning does not take place solely on an individual level, but is a socially embedded and mediated process. Vygotsky (1978) was concerned with how children interact with adults to incorporate important symbolic tools from them, and how adults aid us in our development. This implies an emphasis on the collaborative and contextual aspects of learning, but the social context of learning still comes into play when learners do not collaborate. For example, a learner sitting alone in his/her room reading a textbook cannot be conceived entirely as being engaged in a private and internal

activity, since the very meaning of that learning activity is to a large extent determined by external factors (Säljö, 2001).

Adults and children have different conditions and backgrounds from a learning perspective and the studies of adult learning is often referred to as andragogy, a term made popular by Malcolm Knowles in the late nineteen sixties (Henry, 2011). Although there is a danger of making a distinction between pedagogy and andragogy (e.g. Darbyshire, 1993; Davenport, 1993) it can still be argued that adults when learning can be described as having more experience being more autonomous, goal-, and problem-orientated (McCallum, 2012). Even if Vygotsky (1978) mainly performed his studies on children and adolescents, the process of learning as described by Vygotsky (1978) can still be applied to how adults learn. This is illustrated by theories building on the work of Vygotsky (1978) such as communities of practice and situated learning (Brown et al., 1989; Lave and Wenger, 1991; Wenger, 1998). Lave and Wenger (1991) see learning as a process that occurs within what they call a community of practice, where a learner moves towards the center of a practice through legitimate peripheral participation within his/her community of practice. Situated learning emphasizes the situated nature of work and knowledge and is seen as situated and a product of the activity, context and culture in which it is created and used (Lave and Wenger, 1991). An employee's everyday work constitutes the context for his/her learning reflections by themselves or together with others (Cook and Brown, 1999). Even if the role of context is important, the role of reflection is commonly seen as being at the center of the adult learning process.

The work of Vygotsky (1978) is also what inspired Wood et al., (1976) to develop the notion of scaffolding as a tutorial process where “an adult or ‘expert’ helps

somebody who is less adult or less expert” (Wood et al., 1976, pp 89). The choosing of the words expert and less expert as well as adult and less adult, would lend itself to be interpreted as applying to both adults and non-adults as well as an adult expert to an adult who is less of an expert. Viewing scaffolding as a socio-technical system means that scaffolding is not restricted to interaction between individuals, where one is more skilled, but can also include interactions with digital environments (Puntambekar and Hubscher, 2005). Hannafin et al., (1999), and Hill and Hannafin (2001) identify four key components of scaffolding for teaching and learning in digital environments: conceptual scaffolds, metacognitive scaffolds, procedural scaffolds, and strategic scaffolds. Conceptual scaffolds help the learner to prioritize what is important. It could be an outline to help the learner understand what to consider or showing the relationship between various concepts. Metacognitive scaffolds help learners assess what they have learned by e.g. reminding them to reflect on an alternative way to solve a problem. Procedural scaffolds help the learners with how to use a resource. It could be a web site map that gives the learner a sense of the scope of the site as well as how the different elements are linked together. Strategic scaffolds provide alternative ways to engage in the learning environment or suggests resources that could be helpful under a given circumstance.

Studying a community where concept of apprenticeship was used as a lens to investigate the processes of informal learning, Greenfield (1999) characterizes scaffolding as providing support, function as a tool, extending the range of the worker, allowing the worker to accomplish a task he or she could not otherwise, and selectively help the worker where it is needed. In sum, scaffolding helps learners decide what to consider and how, and through reflection make them internalize the knowledge and apply it in other contexts and thereby extend the range of their skills that would be impossible without scaffolding. Considering reflection at work, Schön

(1983) proposed the concepts of reflection-on-action and reflection-in-action where reflection-on-action refers to retrospective thinking after an event. This is when the employee reflects upon what happened during an earlier event and the motivations for acting in a certain way. Reflection-in-action occurs during the event and involves thinking about the ongoing experience and reflecting on the underlying feelings and theories in use.

2.2 Learning for work

Learning for work is not a new phenomenon, we have always learned at, through, and from work (Senker and Hyman, 2004) in various forms. The purpose can be the development of the organization by contributing to the effectiveness of the production and/or new innovation, or to enhance the individual's competence through development of skills, rules, concepts, or attitudes (Steensma and Groeneveld, 2010, Gupta and Bostrom, 2009; Boud and Garrick, 1999; Matthews, 1999). Learning for work also takes place at different levels, where employees' learn as individuals, in groups, as a community, as an organization, in networks and sometimes at a regional level (Tynjälä, 2008). When supported by IT learning and training is often a combination of different learning modes, most commonly: web-based or computer-based, asynchronous or synchronous, instructor-led or self-regulated, individual-based or team-based (Gupta and Bostrom 2009).

How we create and use knowledge are key issues in the research on learning for work. Knowledge helps the employees' act effectively and there is a dynamic between tacit knowledge (internal personal knowledge) and explicit knowledge (codified knowledge) Nonaka (1994). Acquiring knowledge and skills can aim at a certain learning objective. Bloom (1956) presents an educational taxonomy for the

different learning objectives teachers set for their learners within the cognitive domain concerning mental skills. The learning objectives or set skills learners should be able to exhibit after a learning activity within the cognitive domain was initially: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation (ranging from lower order thinking skills to higher order thinking skills). These were later revised by Krathwohl, Anderson, and Bloom (Krathwohl et al., 2001) with new definitions for each of the six major categories in the cognitive domain, also ranging from lower order thinking skills to higher order thinking skills.

Higher order thinking skills

Creating ↑	Putting elements together to form a coherent or functional whole; re-organizing elements into a new pattern or structure through generating, planning, or producing
Evaluating ↑	Making judgements based on criteria & standards through checking and critiquing
Analysing ↑	Breaking material into constituent parts determining how the parts relate to one another & to an overall structure or purpose through differentiating, organizing & attributing
Applying ↑	Carrying out or using a procedure through executing, or implementing
Understanding ↑	Constructing meaning from oral, written, & graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining
Remembering	Retrieving, recognising, & recalling relevant knowledge from long-term memory

Lower order thinking skills

Figure 2. Bloom's taxonomy (Bloom, 1956)

Although the original idea of the taxonomy was to give educators the tools for a holistic approach that would make the learners acquire new mental skills, new

attitudes, and/or new physical skills after the learning process, the learning objectives within the cognitive domain (mental skills) have been utilized and focused upon a great deal within the educational sector. This could also be useful to describe the scope level of learning outcome (Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation) from different learning and e-training initiatives in a work context.

How to create new knowledge through workplace training commonly focuses on one of two different aspects, spontaneous informal learning or formal more pre-planned and structured learning. Even though it could be argued that informal learning can be intentional e.g. when information is memorized in an informal context, (Eraut, 2000) or a more or less planned knowledge sharing between colleagues who need to learn from each other by teaching others or being taught (Tyjälä, 2013), informal learning is often seen as spontaneous and unstructured e.g. employees sharing stories about their daily practice (Orr, 1996). Formal learning is usually thought to be more organized and structured and often associated with learning objectives and involving e.g. off-the-job training, coursework, workshops, and seminars (Rowold and Kauffeld, 2009). Formal learning could then be seen as more deliberate learning with time set aside for the learning activity.

Formal and informal workplace learning are often a dynamic interaction between the two forms of learning, making it difficult to view one of the two forms as being successful without the other (Svensson et al., 2004). Formal and informal learning are rather two sides of the same coin and thus it could be argued that both are equally important as they both feed off each other (Slotte et al., 2004). Human resource development (HRD) can be seen as the systematic and planned learning activities designed to provide employees with the opportunities to learn what the necessary

skills and knowledge are to meet current and future job demands (Werner and DeSimone, 2011) and in figure 3 below, Slotte et al., (2004) illustrate how formal and informal learning are intertwined in the HRD.

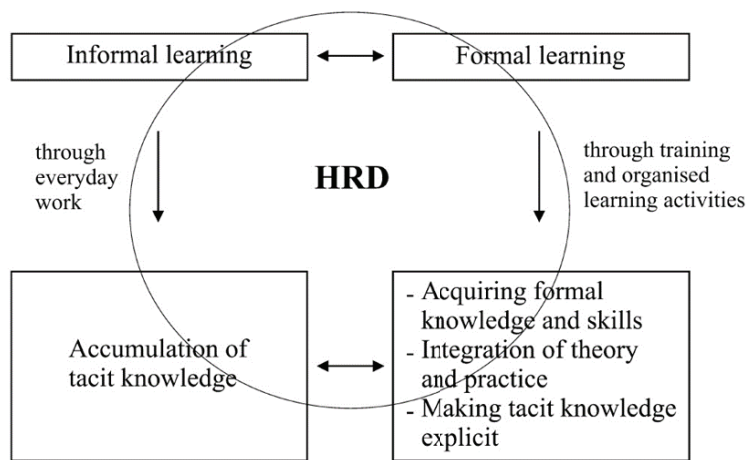


Figure 3. Learning at work and the role of HRD practitioners (Slotte et al., 2004)

So even if most workplace learning occurs outside of being mentored, taught, or guided through training programs (Billet, 2014) both formal and informal workplace learning are important for successful development of competence (Svensson et al., 2004). Figure 4 illustrates how the interplay between formal and informal learning creates learning by reflection, which in return leads to competence.

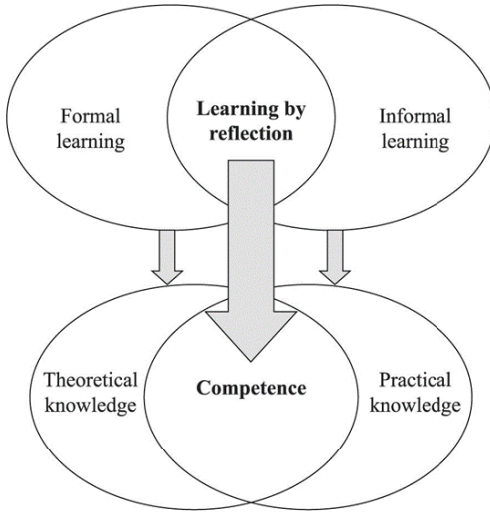


Figure 4. Learning by reflection leads to competence (Svensson et al., 2004)

Billet (2014) argues that employees learn through everyday work activities, while engaging with colleagues through mimetic processes e.g. observations or imitation. Aside from this indirect experience from everyday work activities, Billet (1992) also stresses the importance of interacting with experts to develop professional knowledge.

However, whether it is informal learning, formal learning or both, the sociocultural views on learning still imply a strong relationship between learning and the cultural and social context in which the learning occurs (Säljö, 2001; Vygotsky, 1978). When studying employees' interactions with each other from a learning perspective it is easy to recognize that the social aspect cannot be neglected. In that case it is clearer that the context has an impact on learning. This is, however, also true when you are studying employees who are engaged in self-directed learning or training

activities. Even when an employee studies alone engaging in e.g. a video lecture or reading a book, learning takes place in and for a context that affects the learning process.

2.3 E-training

In the introduction chapter, e-training was defined as the systematic acquisition of skills, rules, concepts, or attitudes that is facilitated by IT and organized in a way that enhance the productivity of both the individual learner and organization. The knowledge transfer is to be regarded as a process of reconstruction of knowledge rather than the transmission and reception of knowledge (Szulanski, 2000). How effective e-training is at developing employees' skills by transferring the gained knowledge to work performance then becomes a key issue (Amrou et al., 2015; Hutchins et al., 2010). The factors affecting the process of knowledge transfer can be categorized into three different groups: learner characteristics, work environment, and intervention design (Burke et al., 2007; Grossman and Salas, 2011). Similarly Li et al., (2014) identifies characteristics of the subjects, contextual characteristics and characteristics of the knowledge sources. The following sections are structured according to these factors, and although digital learning material can be seen as being a part of the intervention design.

2.3.1 Learner characteristics

E-training comes with a potential conflict of individual learning and organizational needs. This potential conflict arises from the fact that e-training should ideally support individual learning, while at the same time meet the organization's competence needs. This can be challenging since it could mean motivating an

employee to gain new or expanded knowledge in areas that might be of little interest for him/her on a personal level (Slotte et al., 2004). Noe et al., (2010) see motivation as a pivotal aspect of individual characteristics affecting the effectiveness of learning and emphasize how perceived meaningfulness of the e-training activity, feeling safe on their job, and availability (i.e. possess cognitive resources and energy for learning) are key issues for learner engagement. The characteristics of the learners might influence the outcome of training more than work environmental factors (Kwakman, 2003).

It is argued by Kolb (1984) that learners move between different learning modes when learning e.g. from concrete experience to reflective observation of something, and in this transition four learning styles emerge. The convergent learning style (characterized by problem solving), the divergent learning style (emphasizing concrete experience and reflective observation), the assimilative learning style (the ability of abstract conceptualization and reflective observation), and finally the accommodative learning (emphasizing concrete experience and active experimentation (Kolb, 1984). When designing e-training it is important to tailor the training method to individual needs and different learning styles, e.g. convergent and accommodative learners benefit more from e-training characterized by discovery (Bostrom et al., 1990).

Gamification, i.e. the use of design elements for video games in non-gaming systems to increase engagement and motivation of the end-user (Thiebes et al., 2014) also have the potential of increasing engagement and motivation of learners' (Santhanam et al., 2016; Schöbel et al., 2016) and train employees' to handle complex situations (El Mawas and Cahier, 2013) there are potential risks when implementing gamification. The quality of learning tasks may suffer if the game

aspect is distracting the learner from the overall purpose of the task or the novelty of the gamification could wear off and the game element might not be perceived as challenging enough (Thiebes et al., 2014). Contextual aspects also play a role when selecting gamification elements since workplaces have different cultures (Schöbel et al., 2016). E.g. the element of competition effects the learning outcome in one context (Santhanam et al., 2016) but is not preferred by the learners' in another context (Schöbel et al., 2016).

Prior experience with IT and computers also influence learning outcomes, where learners' with previous experience of IT tend to perform better and the lack of previous experience can create anxiety (Wan et al., 2007). Anxiety affects the learning process negatively and thus potentially also the learning outcome (Gupta, 2017). Verbal persuasion can reduce perceived anxiety by e.g. the instructor giving encouraging feedback to the learner although this kind of feedback is absent in e-training environments. Instead peer-collaboration by the use of debate boards, wikis and e-mails can be used as tools for reducing perceived anxiety (Gupta, 2017).

2.3.2 Work environment

Encouraging the employees to participate in learning activities is important and one of the aspects deemed necessary in a workplace environment that is supportive of learning (Billet, 2001). Billet (2001) recognizes four aspects that are important for workplace learning: (1) appropriate development and implementation of workplace environments that are invitational, (2) tailoring of the workplace learning curriculum to particular enterprise needs, (3) encouragement of participation by those who are learning and those who are guiding the learning, and (4) appropriate selection and preparation of the learning guides.

Paulsson et al., (2005) found that when workers' are in control of the learning process, it increased the competence development and the learning process was more stimulating and less stressful. Burke et al., (2007) and Cheng et al., (2012) concluded that contextual factors such as, managerial support, job support, and organizational support, impacted how employees perceived the usefulness of an e-training system. Lohman (2006) identified three environmental factors inhibiting informal learning activities: lack of time, lack of proximity to colleagues' work areas, and insufficient funds. Paulsson et al., (2005) also stress the importance of giving the employees time for learning and reflection.

2.3.3 Intervention design

Ahrens and Sankar (1993) used cognitive skill acquisition theory when developing e-training. Cognitive skill acquisition theory claim that learners acquire skills in three stages: declarative, knowledge compilation, and procedural skills (Anderson, 1982). In the first stage, instructions are stored in the learners' memory and represented as a declarative network of facts with definitions and relationships. In the next stage the knowledge compilation is the process of applying the newly acquired knowledge to the learners' own problem domain through decision rules. The last procedural stage is where these decision rules have become permanently stored in the learners' memory (Anderson, 1982). Based on used cognitive skill acquisition theory Ahrens and Sankar (1993) recommended that the e-training should include practice examples with immediate feedback and emphasized the importance of using concrete examples when e.g. illustrating concepts.

Similarly Santhanam and Sein (1994) stress the importance of meaningful practice and interaction with a system in an appropriate environment and further suggests the use of methods that provide hands-on training while using good conceptual models in a way that help the learners form and retain the conceptual models. Learners' that use a holistic approach by forming mental models are more effective than learners forming procedural models through e.g. step-by-step tutorials. Santhanam and Sein (1994) further suggest that extensive interaction with the system together with good mental models of the system leads to better performance. Ahrens and Sankar (1993) also found that learners' need to go back to the learning material several times before they can expect to obtain expertise thus it is also important that the e-training environment provide learners' control of their learning process and give them time to reflect (Paulsson et al., 2005).

Employees' might not participate in collaborative activities with useful reflective elements if they are scheduled (Kwakman, 2003) but individual reflection still takes place outside the scheduled learning activities (Kwakman, 2003). E-training can be designed to provide this control in the form of access to e.g. resources and expert guidance independent of time and place (Margaryan, 2008). E-training also enables employees to engage in the learning material at a pace that fits the individual employees and their everyday work. With the use of e.g. multimedia, the learning experience can be interactive and has the potential to be more efficient than textbooks (Friedl et al., 2006) and e.g. an asynchronous annotation tool to provide interactivity amongst the learners' could help engage them even more (Barger et al., 2002).

Venkatesh (1999) and Davis and Bostrom (1994) further suggest that this motivations should preferably be internal and an intrinsically motivating e-training

environment can result in more successful learning. Davis and Bostrom (1994) identify four dimensions that help create this: challenge, curiosity, control and fantasy. Challenge means that tasks should give the learner the right challenge, not be too easy nor too difficult. Curiosity is providing learners with variations in multimedia effects and letting them interact with a domain or subject in different ways. The control principle suggests that the e-training environment should give the learners a sense of control over the environment and the choices they make. The fantasy principle is using metaphors learners understand by relating new knowledge to previous knowledge (Davis and Bostrom, 1994).

Out of the factors affecting learning transferring to enhanced work performance, intervention design, e.g. designing e-training systems, is the one where IS designers' are most likely to make an impact (Burke et al., 2007). Essential for the learning process and the success of an e-training system is the faithful appropriation of the provided learning methods (Gupta and Bostrom, 2009; Hardin et al., 2014). Faithful appropriation is when the learners' interact with the system in the way it was intended to achieve the learning goals. The interaction does not have to be exactly done in the intended way as long as the new and maybe innovative use is consistent with the spirit (i.e. learning goals and the researcher's perspective on learning) and the overall intention of the learning method (Chin et al. 1997). Given that faithful appropriation is key to e-training, one vital part of developing e-training is how the learning material is designed and presented, and this is elaborated upon in the next section.

2.3.4 Digital learning material

Using modeling in e-training, e.g. an instructor demonstrating and guiding actions before the learners' tries it themselves, leads to better learning outcomes compared to reading instructions or lecture-based instructions with the same content but without demonstrations (Gupta, 2017). In e-training this is often done by combining text, audio, graphics, video, and animation i.e. multimedia. Some of the literature on multimedia and learning deals with human computer interaction (HCI) aspects of learning such as cognitive load (Grunwald and Corsbie-Massay, 2006; van Merriënboer and Sweller, 2005), and modality principles (Moreno, 2006a).

Learning with multimedia has also proved more efficient in terms of study time compared to printed medium (Friedl et al., 2006) and simultaneous presentation of semantically interrelated visual, textual, and auditory information improves learning (Dubois and Vial, 2000). This is an efficiency often welcomed when learning at work. In a study by Montazemi (2006) multimedia had a significantly positive effect on motivation to learn the subject matter, but no significant effect on performance on exams (see also Coleman et al., 2001). This result stresses the purposeful use of multimedia i.e. adding multimedia by itself is not enough (Hoogeveen, 1997). In order to achieve a better learning performance or a higher level of learner satisfaction a provision of interactivity is needed and Zhang et al., (2006) stress the importance of integrating interactive, instructional video into e-training systems.

Cognition is defined by the Oxford dictionary online as “The mental action or process of acquiring knowledge and understanding through thought, experience, and the senses”. When we learn something new or try to make sense of a certain

situation the mental process is the thoughts we have combining our experience and previous knowledge with what we see, hear and so on with our senses. Cognitive load theories study these cognitive activities in a context, looking at how structures in the environment can help human cognition and reduce cognitive load (Rogers et al., 2011). The split-attention principle refers to avoiding the presentation of learning material in a way that adds extraneous cognitive load, forcing the learners to split their attention between multiple sources of information. Similarly, principles for reducing extraneous cognitive load was also presented by Mayer (2001) as a part of his principles for the design of multimedia learning.

Principles for reducing extraneous processing

- **Coherence principle:** Extraneous contents such as words, pictures, music, and other sounds should, even if it is interesting, be excluded if it is irrelevant to the concepts that are being presented. Removing all irrelevant information will actively help the learning process. This has however been contradicted by Muller et al., (2008). In a study, Muller et al., (2008) found that the score was not lower in the test group that had 50% extra, irrelevant but interesting, information in the multimedia presentation. Rather Muller et al., (2008) found that the extra information helped maintain the attention of the learner.

- **Redundancy principle:** It is better to combine animation and narration rather than animation, narration, and on screen text because of the extraneous cognitive processing on screen text creates. However, this principle was later tested and revised in a study where learners viewed a short multimedia PowerPoint presentation consisting of narrated slides (Mayer and Johnson, 2008). Mayer and Johnson (2008) found that on screen text would improve the learning process, if it conveyed the main concept described in the narration, and were placed near the corresponding image.

- **Signaling principle:** When presenting a concept, the words used should include cues about to highlight the organization of the presentation. It could e.g. be pointing gestures to guide the learner's attention to key elements of the concept and how to connect them.
- **Spatial contiguity principle:** Corresponding words and pictures should be presented near each other to make it easy for learners to hold the picture and the text in the working memory at the same time and thus helping the learner to make sense of the learning material.
- **Temporal contiguity principle:** Corresponding words and pictures should be presented simultaneously, rather than successively. As with the spatial contiguity principle, the learner are more likely to keep the mental representation the text and picture make up in their working memory.

Principles for managing essential processing

- **Segmenting principle:** This principle is simply that a multimedia lesson that provides learner-pacing control over the segments, i.e. through the use of a Start/Stop button, will result in greater learning than a continuous segment.
- **Pre-training principle:** The learning increases from a multimedia lesson when the learners are familiar with the names and characteristics of the main concepts touched upon in the presentation.
- **Modality principle:** This principle states that learners learn better from narrated animation than from animation with on-screen text. Although in an experiment conducted by Tabbers and Spoel (2011), the modality principle could not be replicated. Tabbers and Spoel's (2011) study indicates that narrated animation and animation with on-screen text do not load the working memory differently.

Principles based on social cues

- **Personalization principle:** The learning increases when the words are in conversational style rather than formal style. Techniques to accomplish a more conversational style are e.g. to use 'you' and 'I' rather than third-person constructions or make comments directed to the learner.
- **Voice principle:** Learners learn better, when words are spoken in a standard-accented human voice rather than in a machine voice or foreign-accented human voice.
- **Image principle:** Learners do not necessarily learn better from a multimedia lesson just because the speaker's image is shown on the screen.

Reisslein et al., (2005) developed a computer-based instructional module on the fundamentals of multimedia networking in two versions, one where the learning content was equation based and one where the learning content was illustrated with graphs. They found that the graphically illustrated module resulted in significantly higher student performance on posttests, shorter learning times, and more positive attitudes toward the computer and multimedia-based instructional module. Similarly, Mars and McLean (1996, p. 1098) found that multimedia “reduced the time spent by students in the histology microscopy laboratory and did not negatively affect their marks in post-course evaluation. The concept of multimedia-based CAI in medical education was positively received by the students who participated.”

Although there are examples of studies where the result does not support the hypothesis that participants' learning with multimedia would perform and retain content better than participants learning with printouts (see e.g. Coleman et al., 2001), most studies point to multimedia having a positive effect in terms of

efficiency, motivation, and learning performance if the different media elements correlate to each other (Mayer, 2001).

Hung and Chen's (2001) design framework identifies four principles of learning and derives from these design considerations for e-learning: Situatedness, Commonality, Interdependency and Infrastructure. Hung and Chen (2001) promote that e-learning environments should create a situation where there is continual interest and interaction embedded in the environment. Furthermore, Hung and Chen (2001) argue that e-learning environments should have scaffolding structures that utilize the genres and common expressions used by the community. The functionality of e-learning also varies depending on the scope and the purpose of the learning activity, but the functionality of a web based course or lecture is often the content delivered by text, audio, pictures, animations, and/or video in a way that makes it possible for the learner to control when and where to interact with the learning material and still make it interactive.

3 Theoretical basis and framework

This chapter introduces the theoretical basis for the design principles for e-training, namely the design principles for e-learning (Herrington et al., 2010). These design principles for e-learning guided the design of the WLA but a designer needs to understand both the technological and pedagogical aspects when designing a system like the WLA (Govindasamy, 2001; Kahiigi et al., 2008). To gain this understanding, two more frameworks are implemented in the WLA. The three frameworks are: pedagogical principles for authentic e-learning to guide the design of the e-training environment, digital resources principles guiding the design of the content of the WLA, and principles for good design of graphical user interfaces. Before these frameworks are presented, the concept of authenticity is elaborated upon and authentic e-learning (Herrington et al., 2010) is put into context through an overview of research using the framework of authentic e-learning (Herrington et al., 2010).

Embedding authenticity in the learning environment, i.e. anchoring learning in real-world situations and problems, is argued to be essential to students' learning processes at schools (Brown et al., 1989). When developing a learning environment that is to be authentic, the situated nature of learning needs to be acknowledged (Brown et al., 1989). Collins (1991, p.122) frames this situated nature of authentic learning as "the notion of learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life", but authentic learning is not only constrained to learning in real-life locations. Authentic learning can also be achieved in an online learning environment by incorporating the characteristics of authentic activities into the design of web-based courses (Herrington et al., 2004).

Myers (1993) developed three criteria to assure that a learning activity was meaningful and authentic. Prior to designing any kind of learning activity Myers (1993) asked three essential questions:

1. Does this activity provide opportunities for the students to achieve something that they perceive as real or genuine?
2. Does the activity challenge, inspire and empower the learner to take risks and exceed personal limitations?
3. Are the students and the teacher committed to having this activity make some difference in their lives?

(Myers, 1993, p. 2)

Similarly, Sternberg et al., (1993) differentiate between what they call practical intelligence and academic intelligence. Sternberg et al. (1993) suggest that the major reason for this is the difference between the problems learners face in academia and the kind of practical problems they encounter in the real world. Practical problems are often ill-defined with more than one way of arriving at not one, but multiple correct solutions (Sternberg et al., 1993). This is also partly the theme in a review of papers on authentic learning environments conducted by Herrington et al. (2004). In the review ten characteristics of authentic tasks crystallized:

1. Authentic activities have real-world relevance
2. Authentic activities are ill-defined, requiring students to define the tasks and sub-tasks needed to complete the activity
3. Authentic activities contain complex tasks to be investigated by students over a sustained period of time
4. Authentic activities provide the opportunity for students to examine the task from different perspectives using a variety of resources

5. Authentic activities provide the opportunity to collaborate
6. Authentic activities provide the opportunity to reflect
7. Authentic activities can be integrated and applied across different subject areas and lead beyond domain-specific outcomes
8. Authentic activities are seamlessly integrated with assessment
9. Authentic activities create polished products valuable in their own right rather than as preparation for something else
10. Authentic activities allow competing solutions and diversity of outcome

Herrington et al. (2010) conclude that usable knowledge and skills are best gained in learning settings that feature these characteristics. Based on these characteristics the guidelines for authentic e-learning (Herrington et al., 2010) were developed for web environments in higher education. The framework of authentic e-learning has been used in different contexts and the following sections describe how other research efforts have used the framework of authentic e-learning (Herrington et al., 2010; Herrington and Herrington, 2006; Herrington and Oliver, 1995).

Some research has, as in this thesis, examined how authentic e-learning transfers into practice by using the design principles of authentic e-learning when designing and building systems to support e-learning. A few examples are in a workplace context, but the framework is mostly used in the context of higher education (e.g. Tan et al., 2010; Smith and Parker, 2012). Smith and Parker (2012) investigate how authentic e-learning can be applied to a blended learning environment, where blended learning is defined as a combination of face-to-face teaching and an e-learning system (Duhaney, 2004). One of the challenges Smith and Parker (2012) address is how to construct a flexible, interactive and engaging learning environment that will support students' transition to the workplace. Tan et al. (2010)

built a web-based multimedia learning module using the authentic learning principles that resulted in positive attitudes among students towards authentic e-learning because the students felt it brought relevance to their learning.

In a thesis by Hunger (2010) the authentic e-learning framework is used in combination with an instructional framework by Bonk and Dennen (2003) to design a module prototype for an online learning environment for higher education. The aim of the study is to produce and develop guidelines for faculty members when designing for online courses and programs. Wilson and Schwier (2012) address a similar question by stimulating a discussion around a model of authentic learning that informs the design of courses for students. Using the characteristics of authentic learning, Banas and York (2014) examined if authentic learning exercises influenced preservice teachers' intentions to integrate technology in their courses and if authentic learning had a positive effect on technology integration self-efficacy. The results indicated that authentic learning had a positive impact on both the intentions to integrate technology and the technology integration self-efficacy (Banas and York, 2014).

Some research uses authentic e-learning to support the design of virtual worlds (Masters et al., 2012; Reiners et al., 2012). Masters et al. (2012) used authentic e-learning (Herrington et al., 2010) when designing a virtual world by using an established virtual world on the Internet called Second Life. The virtual class room was designed to create realistic situations for students in a teacher education program for them to practice teaching and give them professional experience. The first trials in the study by Masters et al. (2012) indicate that using virtual worlds for gaining practical professional experience for off-campus students appears promising. Wood and Reiners (2012) and Reiners et al. (2012) propose that utilizing

existing technologies and current theories on gamification and education will provide a more authentic experience in higher education.

Authentic e-learning (Herrington et al., 2010) is also used in studies on how learning can be supported by the use of mobile devices (Narayan and Lovegrove, 2012; Herrington et al., 2014). Narayan and Lovegrove (2012) did a one-year-long action research study where the students built two boats. The learning process was supported by Web 2.0 tools, with a design based on authentic e-learning (Herrington et al., 2010) and mobile devices. The students used their mobile devices to collect pictures, videos, blog posts and so on, during the process of building the two boats. Other studies used authentic e-learning (Herrington et al., 2010) to guide the design of courses that aimed at providing pre-service educators with the skills for implementing ICT and the knowledge to enable future learners to take advantage of the learning opportunities offered by mobile technologies (Olney et al., 2009; Herrington et al., 2014). Pre-service teachers used mobile technologies, such as iPods, as tools to gain knowledge about how educational technologies can be used from a pedagogical perspective in primary school classrooms (Olney et al., 2009; Herrington et al., 2014).

The authentic e-learning framework has also been used in a workplace study focusing on the development of the expertise of employees (Vesper and Herrington, 2011). Vesper and Herrington (2011) investigated how authentic e-learning could guide the development of a system that was to help develop expertise for those involved in the distribution and handling of time/temperature-sensitive pharmaceutical products. This expertise had earlier been developed through a bus course by having the learners take a bus trip where they could make observations at the storage, warehousing, distribution and health care facilities that they visited

during the trip (Vesper and Herrington, 2011). Mentors would be on the bus and the learners would also interact with operational staff at the facilities they visited. Throughout the trip there were also presentations and group discussions (Vesper and Herrington, 2011).

Based on authentic e-learning (Herrington et al., 2010) and cognitive apprenticeship (Brown et al., 1989), Vesper and Herrington (2011) suggest draft design principles that inform the design of a learning environment that helps learners gain the expertise needed to handle, store, transport, distribute, and monitor time and temperature sensitive pharmaceutical products. The aim of the system is to provide the learners with the opportunity to develop this expertise in a more time- and cost-effective way than participating in the bus course (Vesper and Herrington, 2011). At this stage, Vesper and Herrington (2011) will develop a prototype that will be evaluated by experts. It is not clearly stated in the paper who these experts are, e.g. GUI experts, e-learning experts or experts within the area of handling, storage, and distribution of time and temperature sensitive pharmaceutical products.

Teräs and Herrington's (2014) research combines the contexts of university studies and workplace learning as they investigate the learning experiences of educators in higher education, who participate in an online postgraduate certificate program for teaching in higher education. The online program was based on authentic e-learning and targeted a group of multicultural educators studying alongside their teaching. The evaluation identified issues with the authentic tasks, online collaboration, facilitation and assessment as they were implemented in the learning management system.

Context	Examples
School context, blended learning and distance learning environments	Smith and Parker, 2012; Masters et al., 2012; Narayan and Lovegrove, 2012; Reiners et al., 2012; Wood and Reiners, 2012; Hunger, 2010; Wilson and Schwier 2012
Work place context	Vesper and Herrington, 2011; Teräs and Herrington, 2014

Table 1. Literature review of authentic e-learning (Herrington et al., 2010; Herrington and Herrington, 2006; Herrington and Oliver, 1995)

Even if some of the articles were research in process, e.g. Smith and Parker (2012) still had the data collection with the subsequent phases of analysis and result left to do, it is interesting to note that many used a design-based approach. Although none referred to design based research as defined by e.g. Walls et al. (1992), Hevner et al. (2004), Gregor and Jones (2007), or Sein et al. (2011), some of the research in this review used educational design research (see e.g. Akker, 2006), a design-based approach characterized by the phases: problem, suggestion, design and evaluation (Vesper and Herrington, 2011; Smith and Parker, 2012; Masters et al., 2012; Teräs and Herrington, 2012).

The research presented in the introduction to this chapter has an end user perspective. In some cases the users are students (e.g. Tan et al., 2010) and in one case employees (Vesper and Herrington, 2011). In the case of Teräs et al. (2012), the learners were both students and employees, i.e. working teachers partaking in a formal postgraduate certificate program. This review shows that authentic e-learning (Herrington et al., 2010) has been proven useful in many school related cases.

3.1 A framework for authentic e-learning

As stated in the introduction, the importance of e-training being interrelated with practice suggests that socio-cultural theories of learning are highly relevant. The concept of authentic e-learning by Herrington et al. (2010) is rooted in the socio-cultural view of learning and stresses the importance of context in a learning environment. The characteristics of authentic e-learning are grouped into nine principles that guide the design of e-training environments.

Number	Pedagogical principle
1	An authentic context
2	Authentic tasks
3	Access to expert performances and the modeling of processes
4	Multiple roles and perspectives
5	Collaborative construction of knowledge
6	Reflection
7	Articulation
8	Coaching and scaffolding
9	Authentic assessment

Table 2. The elements of authentic e-learning (Herrington et al., 2010)

Pedagogical principle number 1. An authentic context

Merely providing examples from real-world situations is not enough when designing online learning environments with authentic contexts. To properly illustrate the topic of a learning activity, the context needs to be taken into consideration. In other words, where and how students apply knowledge in real life should dictate how the learning activity is presented to the students. For example, the appropriate context to demonstrate how to check a patient’s blood pressure in an e-learning environment could be in a hospital environment.

The authenticity of the context also adds episodic memory cues, which make it easier for a learner to acquire knowledge later. This episodic memory is the memory of our experiences and ourselves. For example, obtaining a driver's license is an episode that can be remembered; an episode that occurred at a specific time and place and is associated with specific emotions (Levitin, 2002). Norman (1988) illustrated this idea with the example of booking a meeting with someone. If a workday does not consist of numerous meetings, one must not memorize the time, place, or person. These details fit into a person's cognitive structure and previous episodes in a person's life (Norman, 1988).

To maintain authenticity, it is important for the designer not to oversimplify the context or the processes (Herrington et al., 2010). The complexity of the environment that expects to use the gained knowledge should be kept in the learning environment or as Spiro et al. (1987) argue, examples and cases must be studied as they naturally occur. The learner should instead be assisted in a complex environment than have the complexity simplified.

An authentic context
<p>Recommended e-learning design features:</p> <ul style="list-style-type: none"> • a physical environment which reflects the way the knowledge will ultimately be used • a design to preserve the complexity of the real-life setting with “rich situational affordances”

Table 3. Recommended e-learning design features for authentic context that reflect the way the knowledge will be used in real life (Herrington et al., 2010, p. 21)

Pedagogical principle number 2. Authentic tasks

Tasks are an important part of a learning environment (Brown et al., 1989). Tasks should enable students to practice their newly acquired skills and allow them to see the relevance of otherwise abstract theories and concepts. Authentic tasks are rooted in real life problems and thereby develop problem solving skills that are connected to real life problems (Brown et al., 1989). This means that the different activities and tasks should as closely as possible mimic the activities of professionals in practice and not be de-contextualized in the classroom (Bransford et al., 1990; Oliver and Omari, 1999).

The learning environment then needs to provide ill-defined and complex tasks and activities with real-world relevance. The learners should be able to actively experiment with different ways to execute complex tasks. This means avoiding overly well-designed tasks with neat solutions since they then often fail to account for the wickedness of problem solving that students will face later in their work life (Herrington et al., 2010). Tasks should then allow for a range of outcomes and solutions (Bransford et al., 1990) obtained through multiple methods (Sternberg et al., 1993). The tasks should also be completed over a sustained period of time and not as a series of examples that do not relate to one another.

Herrington et al. (2010) give an example of a task that attempts to be authentic but fails. The task is a mathematical question: “There are 25 people in a room. How many handshakes would there be, if everyone shook hands with every other person?” The task is missing authenticity and relevance since no one really needs to know the answer to that question in a real life situation.

Authentic tasks
<p>Recommended e-learning design features:</p> <ul style="list-style-type: none"> • tasks that have real-world relevance • ill-defined tasks that allow students to define the tasks and sub-tasks required to complete the activity • a sustained period of time for investigation • the opportunity for the detection of relevant versus irrelevant information • tasks that can be integrated across subject areas

Table 4. Recommended e-learning design features for authentic context (Herrington et al., 2010, p. 23)

Pedagogical principle number 3. Access to expert performances and the modeling of processes

“In order to provide expert performances, the online learning course needs to provide access to expert thinking and the modeling of processes, access to learners in various levels of expertise, and access to the social periphery or the observation of real-life episodes as they occur” (Herrington et al., 2010, p. 23). This principle has its roots in the apprenticeship system of learning, where the apprentice observes and is guided by a master or expert. By observing and listening to experts’ reasoning, students are given access to stories and narratives and can see the task being carried out before attempting it themselves. In this way learners can also, as newcomers, be socialized into the community of practice in what Lave and Wenger (1991) call legitimate peripheral participation.

Access to expert performances and the modeling of processes

Recommended e-learning design features:

- access to expert thinking and modeling processes
- access to learners at various levels of expertise
- opportunity for the sharing of narratives and stories and access to the social periphery

Table 5. Recommended e-learning design features for expert performances and the modelling of processes (Herrington et al., 2010, p. 25)

Pedagogical principle number 4. Multiple roles and perspectives

In order for students to be able to investigate the learning environment from more than a single perspective, it is important to enable and encourage students to explore different perspectives on the topics from various points of view, and to ‘crisscross’ the learning environment repeatedly. This is achieved by designing the e-learning environment in a non-linear format without a fixed beginning and end. Furthermore, the possibility to visit material in different contexts for different purposes is essential for knowledge acquisition (Bransford et al., 1990).

Multiple roles and perspectives

Recommended e-learning design features:

- different perspectives on the topics from various points of view
- the opportunity to crisscross the learning environment or resource

Table 6. Recommended e-learning design features for multiple roles and perspectives (Herrington et al., 2010, p. 27)

Pedagogical principle number 5. Collaborative construction of knowledge

Collaboration is important and should be designed for, particularly for distance learning students. Consequently, the course should involve tasks to be completed in groups or at least pairs rather than individual tasks, and appropriate communication

technologies need to be available. Examples of communication technologies used to encourage collaboration are e.g., discussion boards, chats, email, wikis, etc.

Collaborative construction of knowledge
<p>Recommended e-learning design features:</p> <ul style="list-style-type: none"> • tasks that are completed in pairs or groups rather than individually • appropriate incentive structure for whole group achievement

Table 7. Recommended e-learning design features for collaborative construction of knowledge (Herrington et al., 2010, p. 29)

Pedagogical principle number 6. Reflection

In order to provide opportunities for students to reflect on their learning, the online learning environment needs to provide an authentic context and task, as described earlier, to enable meaningful reflection. This also calls for a non-linear organization of the learning material to enable students to easily return to any element of the learning material if desired. Reflection is not merely an internal activity, but rather a two-way process where there is mutual awareness e.g. between learners. Hence the opportunity for learners to compare themselves with experts and other learners is beneficial for the reflection process.

Reflection
<p>Recommended e-learning design features:</p> <ul style="list-style-type: none"> • authentic context and task requiring decision making • non-linear organization of materials and resources to enable students to return to any element if desired • the opportunity for learners to compare themselves with experts • the opportunity for learners to compare themselves with other learners at various stages of accomplishment • collaborative groupings of students to enable reflection with aware attention

Table 8. Recommended e-learning design features for reflection (Herrington et al., 2010, p. 32)

Pedagogical principle number 7. Articulation

Creating opportunities for articulation, the tasks in the e-learning course need to incorporate natural opportunities to articulate. This can be established in collaborative groups where group members need to verbalize their newly gained knowledge and how it applies to the problem of the task. Another way to encourage articulation is the public presentation of arguments, where the learner is able to defend a position or point view.

Articulation
Recommended e-learning design features: <ul style="list-style-type: none">• a complex task incorporating inherent, as opposed to constructed, prompted opportunities to articulate• collaborative groups to enable social then individual understanding• public presentation of arguments to enable articulation and defense of learning

Table 9. Recommended e-learning design features for articulation (Herrington et al., 2010, p. 34)

Pedagogical principle number 8. Coaching and scaffolding

According to Herrington et al., (2010) coaching and scaffolding are mainly done by the teacher, but could also be provided by other students. Teacher scaffolding supports students at critical times when a student encounters a problem. Student coaching and scaffolding could be provided via collaborative learning activities, where senior students can assist as well as provide the means for the teacher to support learning via appropriate communication technologies. If the teacher is not present locally where the e-learning is taking place, then the coaching and scaffolding could be facilitated by a local teacher or staff. The notion of scaffolding stems from the concept of the zone of proximal development (Vygotsky, 1978), where someone more knowledgeable supports someone less knowledgeable. Herrington et al. (2010) mention that some scaffolding can be through computer-

based resources, but they go on to state that coaching is very dependent upon the situation and is best carried out by a teacher (Collins et al., 1989).

Coaching and scaffolding
<p>Recommended e-learning design features:</p> <ul style="list-style-type: none"> • collaborative learning where teachers and more able partners can assist with scaffolding and coaching • coaching and scaffolding assistance is available for a significant portion of the activity

Table 10. Recommended e-learning design features for coaching and scaffolding (Herrington et al., 2010, p. 36)

Pedagogical principle number 9. Authentic assessment

To provide integrated and authentic assessment of student learning, the online learning environment needs to offer the opportunity for students to be effective performers with acquired knowledge and to craft polished performances or products in collaboration with others. It also requires the assessment to be seamlessly integrated with the activity and provide appropriate criteria for scoring varied products.

Authentic assessment
<p>Recommended e-learning design features:</p> <ul style="list-style-type: none"> • the opportunity for students to be effective performers with acquired knowledge and to craft polished performances or products • significant student time and effort in collaboration with others • the assessment to be seamlessly integrated with the activity • multiple indicators of learning

Table 11. Recommended e-learning design features for authentic assessment (Herrington et al., 2010, p. 39)

This section has described the nine elements of an authentic e-learning approach that provide a model for the design of the WLA. Next the theories that guided the design and development of the digital multimedia resources are described.

3.2 A framework for designing digital resources

As mentioned earlier the result of the literature review helped guide the design and development of the digital resources for the WLA. What follows are descriptions of the principles guiding the construction of the digital resources. The principles are structured around Mayer’s (2001, 2009) principles for the design of multimedia, grouping them into three major categories:

Number	Digital resource principle
1	Reducing extraneous processing
2	Managing essential processing
3	Social cues

Table 12. The digital resources principles.

Digital resource principle number 1 - Reducing extraneous processing

Nielsen and Loranger (2006) recommend that online videos should be between one and five minutes long. All the modules consisted of videos, although some were only a still narrated PowerPoint slide, so the recommendations from Nielsen and Loranger (2006) guided the design of the modules concerning the length of each video segment. Despite this guideline, some video segments were longer than five minutes. The shortest was around three minutes and the longest was eight minutes.

As a designer, you are often forced to choose between the least of two evils. When designing the video segments that were longer than five minutes, the choice stood

between splitting a segment about one concept into two segments and losing the continuity of reasoning about said concept or breaking the five-minute recommendation suggested by Nielsen and Loranger (2006). In this case it was estimated by the designer (the author) that it was better to keep the continuity and have the entire concept dealt with in one whole, longer segment. Although Ibrahim et al. (2014) claim that when learners are confronted with long video segments they tend to skim the content, the video segments in the study by Ibrahim et al. (2014) were around twenty minutes long, more than twice as long as the video segments in the WLA. The segments only dealing with one concept also helped in making the design choice of having some slightly longer video segments since it coincides with Mayer (2001) stating that videos can be longer if they concern two or three concepts or less.

The video segments that later were embedded in the HTML pages were created with a screen recorder called Camtasia, which gives the user the choice of adding one's own face as a picture in picture in one of the corners. At the time when the WLA was designed, this was rather common, but broke the split attention principle (Mayer, 2001), meaning everything that could possibly take that attention away from the main content and its message should be avoided. Instead, a small picture of the teacher was added at the bottom of the navigation menu just to give the learners a face behind the voice.

Digital resource principle number 2 - Managing essential processing

The segments in the WLA all had pacing control because of the segmenting principle, which states that a multimedia lesson that provides learner-pacing control results in greater learning than from a continuous segment (Mayer, 2001). A start and stop button provided basic pacing control, and the learners also had the

possibility to jump to anywhere in the segment by moving the slider that indicated where in the multimedia segment they were. The pacing control allowed the learners to process the information at their own pace and thereby more deeply.

Concerning the pre-training principle (Mayer, 2001), the employees were familiar with the names and characteristics of how to search on the Internet. All had used the search engine Google before and had thereby a pre-knowledge about the concept of the web lecture. The modality principle stating that learners learn better from narrated animation than from animation with on-screen text has in later years been questioned by Tabbers and Spoel (2011), who found no difference in working memory load between the two different ways of presenting the information. The multimedia segments in the WLA contained narrated animations and slides with bullets. Narrated animations, e.g. showing a screen recorded advanced search, while commenting on the actions that were recorded and narrated bullets with keywords on key concepts, e.g. on how the Internet works or just an exercise being explained. There were no segments with only on-screen text and animation, and most were narrated animations which satisfies the modality principle.

Digital resource principle number 3 - Principles based on social cues

The personalization principle states that the words should be presented in a conversational style rather than a formal style (Mayer, 2001). If the narration was not a conversation between two people discussing how to search the Internet, then the narration was in an informal, conversational style. The voice principle (Mayer, 2001) indicates that it is better when the learners received human-voice instruction rather than instruction that was machine generated. Since all narration and instruction was done by the author these principles were met. The image principle states that learners do not necessarily learn better from a multimedia lesson just

because the speaker’s image is shown on the screen (Mayer, 2001). Despite this fact, a still picture of the speaker was something that arose in the early workshops because people at the county administration appreciated seeing the face behind the voice.

3.3 A framework for interaction and usability design of the GUI

When designing the WLA, web usability factors also guide the design and more specifically the Graphical User Interface (GUI). Not only does web usability affect user satisfaction, web usability can also have a positive effect on students’ perceived learning (Mackey and Ho, 2006). The theories that form the basis for the design of the GUI of the WLA are based on Norman's principles for good design, which are complemented by Rogers et al. (2011) and Nielsen (2000). The scope of this thesis is not to evaluate or contribute to these principles. The principles are used to guide the design of the GUI, so that bad screen design and overall design will not stand in the way of the framework for training that is tested and evaluated. The design principles for interaction and usability design of the GUI are the following:

Number	GUI principle
1	Visibility
2	Feedback
3	Natural mappings
4	Affordances
5	Flexibility
6	User experiences

Table 13. The GUI principles.

GUI principle number 1.

The first principle concerns visibility, i.e. the correct elements for manipulating the artifact must be visible and they must convey the correct message. Even if all the parts needed to interact with a system must be visible, for example, not all menu options must appear on the top level, it should be clear which menu options lead the user to the function or to the information he/she is looking for. Furthermore, the status of the system should be clear. For example, if the user is in a process with several steps, it must be clear where the user is in the process. Rogers also discusses visual density as a guideline by which there should be a proportionate balance between information and whitespace in the graphical interface, so that it does not get overloaded and cluttered with information (Norman, 2008; Rogers et al., 2011).

GUI principle number 2.

A system should always give the user full and continuous feedback to minimize a user's memory load. When something has gone wrong, users should be given feedback about what has gone wrong, but the user should also be given feedback on how they can repair and recover from the error that occurred. For longer processes, the user should get feedback on how long the process takes and how far along the user is in the process. The user should also get feedback from the system upon process completion (Norman, 2008; Rogers et al., 2011).

GUI principle number 3.

It should be possible to understand what will happen in the next step before the user makes a choice. There should thus be a natural mapping between the expected performance of the user and the actual outcome. It is therefore important to use the user's terminology, e.g. not to get too technical when information is given or when selecting headings and menus. It is also essential to match how sequential actions

are performed in the system to how they are done in reality (Norman, 2008; Rogers et al., 2011).

GUI principle number 4.

Affordances or the built-in psychology of things, i.e. what they invite us to do, is one of the design principles Norman (1988) often considers to be misleading. First, when Norman talks about affordances, he means perceived affordances. Furthermore, Norman (1988) believes that designers far too often misuse them. Often when designers believe they have placed an affordance in the interface just by placing some graphical object that suggests to the user that a certain action is possible, the user then follows a previously known convention that limits his/her actions, e.g. clicking on a graphic element that resembles a button. Therefore, a convention can be seen as a constraint in that it prohibits some actions and encourages others. An affordance is the possibility for action presented by the system (Norman, 2008; Rogers et al., 2011).

GUI principle number 5.

A system should also offer users flexibility and control to meet the needs of a wide range of users. Users should, as far as possible, be in control of the sequence of actions. Such control may include allowing users to choose if they want to format text in a text editor before or after they write the text. The system should also be tailored to both beginners and experts, e.g. by providing experienced users presets and shortcuts while beginners are given a more guided path to a goal (Norman, 2008; Rogers et al., 2011).

GUI principle number 6.

Most users have previously been in contact with different systems that in many ways are similar to one another. Designers should take advantage of this fact through users' prior experiences. This goes hand in hand with consistency. The designer should have the user employ similar operations and elements for achieving similar tasks. This applies to both internal consistencies within a single application and to external consistencies between applications such as part of a suite (Norman, 2008; Rogers et al., 2011).

This last GUI principle completes the frameworks that guided the design and development of the WLA on a pedagogical level, a content presentations level, and lastly on an interface level. Next the case settings are described.

4 Case setting

In this chapter the county administration as an organization and a workplace is described. This description explains the work environment in which the learning activities took place, and sets the meta-requirements that should apply, in order for the design principles for the web lecture application to work (Gregor & Jones, 2007). These meta-requirements are summarized and complemented with the level of learning for which the design principles for e-training aims at supporting in the concluding chapter of the thesis.

4.1 County Administrations

The county administration is a government authority that ensures decisions made by the government and parliament are carried out locally in each of the 21 counties in Sweden. The historic roots of the counties date back to 1634, when the nobleman Axel Oxenstierna reformed the Swedish federal systems by dividing the country into counties and appointing a royal governor to act as the King's official representative. Today, each county has a County Administrative Board and a county governor, and the counties are in turn divided into municipalities. Each County Administration is divided into a series of areas of expertise, and with few exceptions each county has an identical organizational structure (a division for reindeer management can only be found in the northernmost counties). The county administration is the link between the people and the municipal authorities on the one hand and the government, parliament and other central authorities on the other.

Tasks that the county administration are obligated to carry out include:

- implementing national objectives
 - coordinating the different interests of the county
 - promoting the development of the county
 - establishing regional objectives
 - safeguarding the rule of law in every instance
- (administration 2009)

The county administrations also perform other tasks such as making decisions or imposing measures in accordance with laws and other nationally and democratically made decisions. These tasks can be the registration of foundations, the authorization of security companies and wrecking yards, and making licensing decisions for e.g. pawnshops, surveillance cameras and the disposal of cremated remains. Since the County administration covers issues that involve most aspects of society, they consequently need a wide range of specialists. The employees are generally well-educated and have leading expertise in all their fields of interest. Below in Table 14 are some examples taken from the websites of the county administrations.

<ul style="list-style-type: none">• Lawyers monitoring and checking that various organizations comply with different laws and guidelines.• Biologists working with businesses that pose environmental hazards making sure that actions that could potentially damage the environment are not taken without the involvement of the County Administrative Board.• Architects granting financial support for the renovation of houses with a cultural-historical interest that uses costly traditional building materials and workmanship.

- Agronomists
distributing EU funding to farming businesses that focus on organic cultivation to support environmentally-friendly food production.
- Foresters
preserving Sweden's flora and fauna by surveying each county's unique nature and the conditions for plant and animal life.
- Engineers
by improving the infrastructure such as roads and making public transport wheelchair-friendly.
- Archaeologists
protecting, preserving and providing information about the county's historical and cultural heritage.
- Social workers
supervising that the municipalities adhere to their responsibility for helping the disabled, substance abusers, and children at risk.
- Veterinarians
inspecting how animal owners care for their animals and deciding if mistreated animals captured by the police can be relocated or should be euthanized.
- Economists
ensuring the development of trade and industry by directing grants to companies that invest in the future growth of trade and industry.

Table 14. Examples of professional categories and responsibilities within the county administrations

4.2 The Academy of County Administrations

The project, called the Academy of County Administrations (Länsstyrelseakademien - in Swedish), started as a joint research project between University West in Sweden and the County administration of Western Götaland in 2001. The IT department of the County administration in Western Götaland took the early initiative. The primary reason was the negative experiences from a vast competence development project that had been launched two years before because the Swedish Parliament decided that there should be a unified environmental policy at the national level. The environmental objectives of the new legislation included issues relating to surface, ground and coastal water, the preservation and

development of valuable natural and cultural environments, and sustainable planning for land and water.

As a consequence, this meant that adjacent counties needed to collaborate to a greater extent than before when e.g. ground water passed through multiple counties. This policy change had fundamental effects on work practices throughout all areas of the county administrations, since they had not been addressed before and needed to be dealt with promptly. As a result, all 21 county administrations developed learning materials and arranged courses in parallel with each other, more or less without any coordination or cooperation. The large shared costs for all these separate learning initiatives constituted a strong incentive to be better prepared for these kinds of changes in the future, and the idea of creating a national platform for online education where experts from different counties could collaborate in developing digital courses was born.

Initially the project focused on developing organizational processes (Figure 5), workflows for production of courses (Figure 6), and describing clear roles and responsibilities for producers and consumers of online competence development. Furthermore, the organizational architecture of the project also specified how the economic and technical resources should be coordinated amongst the different participating county administrations, and in 2002 the project involved 6 of the 21 county administrations in Sweden.

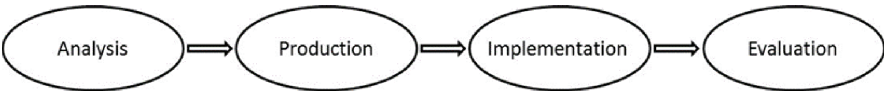


Figure 5. Main organizational process for the academy of county administrations

The members of the project groups were two senior researchers from University West (Information science), the author as a PhD student, and three representatives from the County administration of Western Götaland (HR Manager, IT-manager, and an IT-expert). In addition, the project group reported to a reference group with representatives from the other participating county administrations through an annual conference and quarterly telephone conferences.

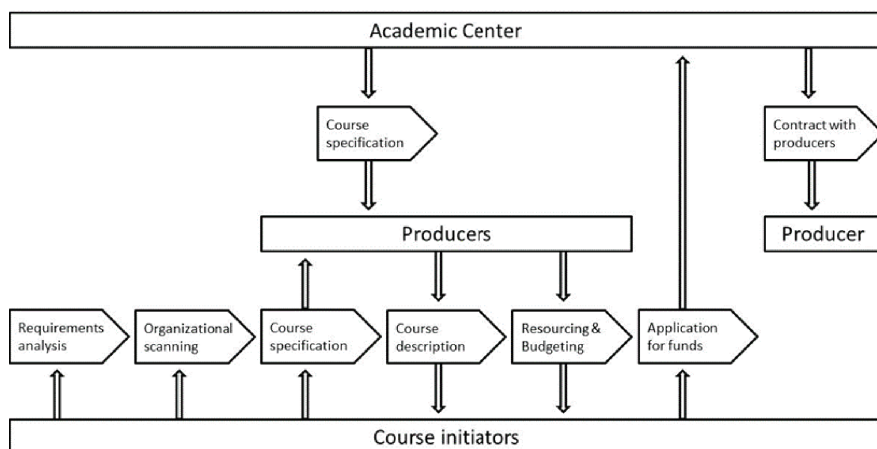


Figure 6. Workflow for Course production

The workflow (Figure 6) also illustrates the organizational structure of the Academy. At the top there is an “Academic Center” with the primary purpose of constantly deciding what training and competence development activities should be prioritized. At the bottom there are “Course Initiators” who signal the need for training activities, and in the middle there are “Course Producers” that typically consist of a team of subject matter experts, instructional designers, and IT-developers. The outcome of this PhD-project will guide the production team when they design and develop the course packages.

In the next phase of the project, the focus shifted towards testing the workflows for course production, and two course packages were developed and launched with pilot groups of participants. In addition, a national investigation of the competence development needs was initiated. Through a survey directed towards the various national special interest groups, the perceived short-term and long-term priorities for competence development and training were explored. The special interest groups are groups that monitor the subject matter areas for which the county administration are responsible. At this point in the project, the researchers started to pay more attention to the challenges connected with designing for e-training.

4.3 Designing for e-training

At this point in the project (2006), the research objective and questions that framed the research were formulated by the author. Together with representatives from the county administration of Western Götaland, it was decided to choose an e-training initiative aimed at enhancing the skills in online searching and information as an entry point for this PhD project. The e-training initiative was labeled “Searching the WWW”. In Table 15 other courses offered by the Academy are listed. Besides “Introduction to a new IT milieu”, the courses were developed by the Academy in co-operation with other researchers at University West. Originally, the demand for increased skills in online searching was raised by the special interest group for communication and public relations within the county administration that had observed that increasingly larger groups of employees had to rely on open digital databases and search engines as important professional resources. At the same time many of them did not know how to formulate advanced, keyword-based search strings with logical operators such as AND, OR and NOT.

In addition, the subject “Searching the WWW” was judged to be a suitable topic for exploring design guidelines since it on the one hand was a low-risk project that did not risk the organizational core processes if it should fail, and on the other hand represented a prioritized area of competence development that was likely to attract voluntary participants. Furthermore, it would be technically possible to experiment with a wide range of modalities (text, image, sound, video, etc.).

Course name	Special interest groups (SIGs)
Introduction to geographical information systems (GIS)	Landscape architecture
IT support for public record management	All SIGs
Introduction to a new IT milieu	All SIGs
Introduction for handling driver's license cases	Traffic

Table 15. Examples of courses offered by the academy of county administrations

4.4 Informants in the research project

Table 14 provides examples of professional categories from the county administration . Below are the professional categories of employees participating in the design research cycles of this PhD-project (respondents to questionnaires, interviewees and workshop participants) had a variety of different professional roles, although most of them were of an administrative character. The following are examples of these employees with a short description of what they do:

- Service assistant

operates the switchboard telephone, janitor like duties

- Finance officer

handles invoices and balances the books

- Registrar

registers cases submitted to the county administration

- Digitizing manager

digitizes analog material for easy access in databases

- Administrator

handles cases

- Housekeeping manager

Manages the residence used for representation by the county governor

- Environmental coordinator

writes reports describing findings from excursions in nature

- Webmaster

updates information on the County Administration website

- Chief Financial Officer

follows up on budgets

- Nature conservation

develops programs for nature conservation and management of natural resources

The staff members were typically very proud of working for a public organization that was “professional” in the sense that they perceived that everyone was appointed to a position based on his/her qualifications, expertise, and decision-making, and that the exercise of public authority was based on knowledge and facts rather than political viewpoints and ideologies. This is an important fact in relation to the status of training and competence development in the county administrations, and also in relation to a learning climate where public officials are encouraged to educate themselves.

5 Research approach and process

In this chapter, the choice of design research as an approach to generate knowledge on how to design systems to support workplace training is described and discussed. The new knowledge that is generated in this thesis is framed as principles for the design of web lecture applications for e-training. Furthermore, the methodological implications of design research in this PhD project are described to account for how the sources of data have been collected and analyzed in connection to the “awareness of problem-” and evaluation phases of the cycles of design research (Vaishnavi and Kuechler, 2008).

Next follows a detailed account of the systematic reviews of literature that was conducted during my PhD-project. Then the concepts of design, design process and design science research are discussed and concluded with my choice of method. In the final part of this chapter the data collection methods are described and discussed.

5.1 Reviews of relevant literature

To explore what core theories and frameworks for design existed within the subject area of work-integrated learning and e-training three literature reviews were conducted.

1. A literature review was conducted at the end of 2006 to identify a framework that would guide the design of the WLA.
2. A literature review of key journals was done at a later stage to include current literature within technology enhanced training.
3. The second literature review was also complemented a review of literature targeting the AIS basket of eight journals.

Besides these literature reviews, new literature has constantly been added throughout the PhD-project by:

- Finding research papers being referenced in articles that related to the PhD-project.
- Backtracking of influential articles, e.g. using Google scholar or Scopus to see what later scientific papers cite.

The result from the literature reviews has served as a base for the PhD-project and are elaborated on in the chapter on related research and theoretical perspectives. In the next section, I will describe the search process of the literature reviews.

For the first literature review, the initial goal was to find a theory or framework that would guide the design of the WLA. Not knowing the exact terms used within the body of research on e-training, the literature review was initiated with a broad search on the Thomson Scientific Web of Science (<http://isiknowledge.com/wos>) using the search string "multimedia" AND "learning". Multimedia was the most popular term in relation to technology enhanced learning at the time of the literature review. This was an initial step to find out what search phrase to use. In the next step, articles were selected by reading the title. If a title indicated that the article concerned multimedia or any other type of technology enhanced learning, they were selected for a read through of the abstract. This was also the case if it was not possible to clearly discern what the article was about from the title alone. Then the abstracts were read, and articles studying multimedia or technology enhanced learning were finally selected for an analysis of what terms were used when discussing technology and learning in the workplace. This process ensured that correct terms were used in the search phrase for the final search and give a result that was relevant for the thesis.

In the initial broad search Web of Science gave 1,320 results when using the search string (TS=multimedia AND TS=learning) in the “Topic” field. The titles were subsequently scanned and 143 articles were chosen for a read through of the abstract. Out of those 143 abstracts, 41 articles studied or discussed multimedia or technology enhanced learning on one level or another. A search for the key words multimedia and learning within those articles was then done to identify themes and terms used when describing multimedia and learning. Out of the 41 articles, six articles studied work-integrated learning that were technology or multimedia enhanced. Within those six articles a search for the terms used for describing the work settings were also done. From this analysis the following search string was derived:

(learning OR instruct* OR "distance education" OR educational) AND (multimedia OR "computer-based" OR computer-assisted OR computer-mediated OR online) AND (workplace OR workforce OR employee OR worker OR trainee)

The words practice and training were left out of the search string. Practice was more often than not used as a verb and did not refer to the workplace as a practice e.g. “Then, subjects in the four experimental groups briefly practiced using a hyperlinked video” (Zahn et al., 2004, p. 282). Some articles referred to training in a work context, e.g. McDonald (2004) reasons about training employees, although most articles used the concept ‘training’ in a non-work context. For example Boling and Robinson (1999) did their study on undergraduates enrolled in the course “Introduction to Athletic Training” and Huang (2005) developed a training tool to help students learn. Although training was not represented in the above-mentioned

search string, the search terms in the search string were all represented in the six articles studying work-integrated learning.

The new search string gave 116 hits on Web of Science. Although some frameworks appeared in the results, none of the frameworks were in relation to instructional and pedagogical design and only six articles dealt with work-integrated learning, but no design frameworks directly applicable to the research question for this thesis appeared. Despite the knowledge gap on theories for the instructional and pedagogical design for technology mediated work-integrated learning environments, a broad and interesting body of research presented itself through the literature review. When the literature review of the articles from Web of Science did not result in a framework that considered the pedagogical and instructional aspect of designing a system for formal work-integrated learning, the next phase of the literature review using Google Scholar was initiated, and it is described in the next sections.

Google Scholar has since its introduction in 2004 provided an alternative for searching for scholarly literature (Bakkalbasi et al., 2007) and was chosen as an additional source to Web of Science for literature searching. At the time when the literature review was conducted in 2007, advanced search in Google Scholar did not support a traditional boolean search in multiple fields like the search strings used in Web of Science did, even if the separator OR was supported. To create a similar search to the previous, the search words “learning multimedia” were entered in the text field “Find articles with all of the words” and the string “workplace OR workforce OR employee OR worker OR trainee” were entered in the text field “Find articles with at least one of the words”. Google scholar returned over 44 000 hits.

When repeating the process of reading the titles and the abstracts of promising articles of the first 100 hits, some frameworks appeared. The frameworks were all from research in a school context. Pea and Gomez (1992) provide technological support for collaborative learning between student groups and teachers stressing the importance of an interactive, multimedia and conversational learning environment. Some frameworks provided pedagogical and instructional guidelines for designing technology mediated learning environments for schools. Hung and Chen (2001) presented implications for the design of web-based e-learning and Herrington and Oliver (1995) and Herrington and Herrington (2006) presented guidelines for an authentic e-learning environment. They both recognize the socio-cultural view on learning, discussed later in this chapter, and the significance of situated cognition and learning. Situated learning stresses the importance of activity and context to learning, meaning that learning is closely connected to doing and the environment in which the doing takes place (Brown et al., 1989), i.e. the learning activities should be authentic.

The result from the literature review using Web of Science gave theories useful for designing and developing learning material to web-based learning environments. However, delivering web-based learning material when designing e-training is not enough to create a sound learning and training environment. To be able to successfully create sound e-training, an understanding of how to integrate technology and pedagogy is necessary (Govindasamy, 2001; Kahiigi et. al., 2008). The pedagogical aspects refer to how the individuals learn and develop new knowledge and the technology refers to how this can be facilitated. The literature review based using Google Scholar resulted in some frameworks but none of them considered technology and pedagogy in a work-integrated learning context. In the table below the dominating themes found in the literature review are outlined.

Theme	Literature example
Cognitive Cognitive theories that attempt to explain learners' abilities to process new information and how to avoid cognitive overload.	Grunwald and Corsbie-Massay, 2006; van Merriënboer and Sweller, 2005
Process. The process often concerned one of three interrelated parts; planning and pre-production of the course, carrying out the course and evaluating the course. The bulk of the studies focused on the evaluation.	Haque and Srinivasan 2006; Dencker et al., 1999
Tools. The papers dealing with tools are typically about tools making the process of converting existing or creating new learning material. Others describe the advantages with new standards such as eXtensible Markup Language (XML) Synchronized Multimedia Integration Language (SMIL) are.	Acosta et al., 2003; Arndt et al., 2002; James and Hunter 2000

Table 16. Themes from the first literature review

Although no frameworks had an overarching approach that took into consideration the technical and pedagogical aspects of designing an e-training system, the frameworks found in a school context (Hung and Chen, 2001; Herrington and Oliver, 1995; Herrington and Herrington, 2006) were promising. Hung and Chen (2001) have a clear community of practice perspective. Community of practice is defined by Wenger et al., (2002) as: “A group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis” (Wenger et al., 2002 p. 4).

Community of practice is also present in the framework by (Herrington and Oliver, 1995; Herrington and Herrington, 2006) but the strong focus is on authenticity, i.e.

the learning environment should reflect the context in which the learning outcome is to be used in (Brown et al., 1989). Herrington et al., (2010) later refined the framework, but always stressed the importance of the learning activities reflecting the environment in which the students should use the gained knowledge in the future. This made the authentic e-learning (Herrington et al., 2010) framework highly relevant for the design of the WLA. Taking into account the technical, pedagogical and instructional design aspects while emphasizing the importance of authenticity, gave the foundation for sound principles for the design of WLA with realistic learning activities. The framework for authentic e-learning by Herrington et al., (2010) was therefore chosen to guide the design of the WLA.

The second literature review was made during the latter part of the PhD-project in order to ensure that no relevant literature had been missed during the constant ongoing process of adding new literature as described in the introduction of this chapter. A search for articles on e-training and workplace learning was made in Scopus. The search terms as expressed by Scopus were: (TITLE-ABS-KEY ("e-training") OR TITLE-ABS-KEY ("workplace learning")) and gave 1,712 document results. An initial selection was made by reading the titles of all the articles. If the title was interesting or if it was not possible to determine exactly what the article was about, then the abstract was read. If an article was still interesting after reading the abstract, it was selected for a read through of the abstract, the introduction and the conclusion. Some articles were excluded after reading the introduction and conclusion. The relevant research from the second literature review and the process of adding articles through backtracking and reading the references of relevant papers are presented in the related research and theoretical perspectives chapter. In the table below the dominating themes found in the literature review are outlined.

Theme	Literature example
Effectiveness How effective the learning initiative is at developing employees' skills (transfer performance)	Dornan et al., 2007; Quek, 2005
How How employees learn at work and how new employees construct identity and become socialized into a work practice	Blåka and Filstad, 2007; Billet, 2014
Influencing factors Factors affecting employees' participation and perceived usefulness of workplace learning activities	Cheng et al., 2012; Kwakman, 2003; Billet, 2002; Lohman, 2006
Theoretical discussions Frameworks, models and theoretical discussion with meta discussions and reviews of workplace learning.	Tynjälä, 2008; Moon et al., 2005; Cheng and Hampson, 2008; Teräs and Herrington, 2014
Mobile learning How the mobile nature of modern work affects the learning and the new possibilities mobile technology brings to work-integrated e-learning	Zhang et al., 2010; Messuti et al., 2014

Table 17. Themes from the second literature review

A common denominator in the two literature studies is the concept of learning. Learning is seen as a vital part of the development of the employees and the organization, but when comparing the result of the two literature reviews, a change of focus is evident. In the first literature review, the focus was how computers and multimedia could be used to enhance learning (e.g. Dencker et al., 1999; Mayer,

2001) whereas in the latter literature review the research is more concerned with how effective the learning activities are at developing employees' skills and competencies. This effectiveness was mostly taken for granted when looking at the research in the first literature review.

The focus was more on how to make the learning experience effective in general and most studies were carried out in a school environment, whereas in the latest review it was shown that the context in which research on computer based learning is carried out is more diversified and e-training in the workplace is one of the areas where research activities have increased.

There is also an increase in studies involving mobile learning. This includes studies that address the opportunities and challenges there are in creating support for mobile work and learning and the use of mobile technology to develop communication skills and enable collaboration. When this thesis project started, the use of mobile technology was not as widespread as it is today, nor was the mobile technology as powerful as it is today. How mobile technology could affect how we learn is discussed in the final chapter of the thesis.

When looking at the sources from the second literature review only six articles came from the top eight journals within the IS field (European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of AIS, Journal of Information Technology, Journal of MIS, Journal of Strategic Information Systems, MIS Quarterly), as ranked by the AIS College of Senior Scholar's and often referred to as the basket of eight. The keyword e-training gave one hit in the basket of eight (Santhanam et al., 2016) when searching the eight top journals in IS and the keyword "workplace learning" gave five hits from the basket

of eight (e.g. Swap et al., 2001). To address the lack of references to the IS literature on e-training a third literature review was initiated.

Since the keyword searches on e-training and workplace learning did not render many articles it was essential to find keywords used when researching and discussion the phenomena of e-training within the IS literature. To find these keywords an article investigating technology-mediated learning (TML) and training from the Journal of AIS was chosen as a point of departure (Gupta and Bostrom, 2009). The article summarizes TML research from the IS and education literature and points to research gaps in order to guide future research. The articles in the reference list was used to crystalize new keywords and a search for articles referring to Gupta and Bostrom (2009) was also done. This resulted in the following array of keywords: technology-based training, application-based training, e-training, workplace training, workplace learning, technology-mediated learning, Computer-based learning, End-user training, Software training, Training services, job training, Computer aided instruction, Information technology training, Basic skills training, participant-controlled learning environments. These keywords limited to the basket of eight journals gave the following search query in Scopus:

(TITLE-ABS-KEY(technology-based training) OR TITLE-ABS-KEY(application-based training) OR TITLE-ABS-KEY(e-training) OR TITLE-ABS-KEY(workplace training) OR TITLE-ABS-KEY(workplace learning) OR TITLE-ABS-KEY(technology-mediated learning) OR TITLE-ABS-KEY(Computer-based learning) OR TITLE-ABS-KEY(End-user training) OR TITLE-ABS-KEY(Software training) OR TITLE-ABS-KEY(Training services) OR TITLE-ABS-KEY(job training) OR TITLE-ABS-KEY(Computer aided instruction) OR TITLE-ABS-KEY(Information technology training) OR TITLE-ABS-KEY(Basic

skills training) OR TITLE-ABS-KEY(participant-controlled learning environments) AND SRCTITLE("European Journal of Information Systems") OR SRCTITLE("Information Systems Journal") OR SRCTITLE("Information Systems Research") OR SRCTITLE("Journal of the Association for Information Systems") OR SRCTITLE("Journal of Information Technology") OR SRCTITLE("Journal of Management Information Systems") OR SRCTITLE("Journal of Strategic Information Systems") OR SRCTITLE("MIS Quarterly: Management Information Systems")) AND (LIMIT-TO(EXACTSRCTITLE,"MIS Quarterly Management Information Systems") OR LIMIT-TO(EXACTSRCTITLE,"Journal Of Management Information Systems") OR LIMIT-TO(EXACTSRCTITLE,"Information Systems Research") OR LIMIT-TO(EXACTSRCTITLE,"Information Systems Journal") OR LIMIT-TO(EXACTSRCTITLE,"Journal Of Information Technology") OR LIMIT-TO(EXACTSRCTITLE,"European Journal Of Information Systems") OR LIMIT-TO(EXACTSRCTITLE,"Journal of the Association for Information Systems") OR LIMIT-TO(EXACTSRCTITLE,"Journal of Strategic Information Systems"))

The search string gave 120 document results with 111 within computer science. All the abstracts of the articles was read and out of the 120 articles 31 was chosen for further reading. In the table below the dominating themes found in the IS literature review are outlined.

Theme	Literature example
Impact Studying the impact of different training methods when implementing a new tool or system	Santhanam and Sein, 1994; Coupe and Onodu, 1996

IT-adoption Identifying key factors that significantly affect the adoption of training systems.	Gallivan et al., 2005; Sykes, 2015
Educational needs Studying required knowledge and educational needs of end users and IS professionals.	Nelson, 1991; Trauth et al., 1993

Table 18. Themes from the third literature review

Only one article studied the adoption of mobile technology and mobile internet hence the trend of mobile learning and e-training is missing in the basket of eight or at least lagging. Rather there have from early studies and onwards been a focus on IT training of the end user seeing end user training as one means to an end for IT-adoption (Mason and Willcocks, 1991; Gallivan et al., 2005; Sykes, 2015). Another set of articles studied the educational needs of end users and IS personnel (Nelson, 1991) set out to identify the key skills and knowledge that will be required of future IS professionals (Trauth et al., 1993).

Another theme was studying the impact of training when implementing a new tool or system (Coupe and Onodu, 1996) or the benefit of different training methods e.g. lecture method vs trainer or the self-study method (Davis and Davis, 1990), the use of conceptual versus procedural models (Santhanam and Sein, 1994), or the importance of learning styles (Bostrom et al., 1990). Warkentin and Beranek (1999) also studied the impact of appropriate training and their study showed that appropriate training improved perceptions of the interaction process over time and thereby improving their communication skills within the virtual teams. In these next sections the concepts of design and design science research will be presented and discussed thoroughly as they form the basis for the research process.

5.2 Design

“The human mind is exquisitely tailored to make sense of the world. Give it the slightest clue and off it goes, providing explanation, rationalization, understanding” (Norman, 1988, p. 2). Whether or not an artifact is poorly designed or well-designed, humans try to make sense of it. It can be hard to understand and describe what makes a design good or bad, but we know there are a lot of good and bad designs surrounding us in everyday life. A good design is not only helpful. Sometimes, e.g. when designing controls in a nuclear plant, it is crucial that the design of those controls prevent the operators at the nuclear plant from making mistakes that could have disastrous effects. With information systems being an ever-increasing part of the world today, understanding the design process and creating instructions on how to design these information systems are currently important challenges. What is design then? There are many definitions with different foci. One is given to us by Webster (1988, p. 8), he defines design as “an information base that describes aspects of the object” That definition refers to design as a noun, i.e. the final result or representations of the final result at different stages of the design process.

Design is also a verb referring to the process of developing or designing something. Over the years, the meaning of design has changed from focusing on the blueprints and their subsequent implementation, and more on the process (Visscher, 2001), although many traditional definitions of design are still concerned with the final product. A definition that focuses more on the design as a process and that lies more in line with how design is viewed in this thesis is given by Takeda et al., (1990). They view design as a “stepwise refinement process where the designer seeks the solution that satisfies the constraint” (Takeda et al., 1990, p. 39). Design is by

Takeda et al., (1990) seen as a process where the designer builds a goal/solution that satisfies a set of specifications. The design process starts when the first ideas emerge and continues until the specification or a suggestion for a construction or how to develop a product is done (Löwgren and Stolterman, 2005). Hence the product or outcome of a design process is not design itself but rather the result of a design process. The outcome of a design process is often thought of as some physical artifact, but the outcome of a design process can also be abstract things such as constructs, models, methods, and instantiations of systems (Hevner et al., 2004).

Designing always takes place in a context and designing usable artifacts requires considering not only who is going to use it and how, but the context in which it is to be used must also be considered (Löwgren and Stolterman, 2005; Rogers et al., 2011). One of the basic assumptions of this thesis is that the conditions and characteristics of users and how they use a digital artifact and the context of use must be explored, understood, and be part of the design.

5.3 Design process

The intent to change the surrounding world for the better, to solve a problem, is the start of a design process. The goal is to come up with a solution to some kind of problem (Löwgren and Stolterman, 2005). Since most design problems offer a multitude of solutions it is hard to identify the end of any given design process (Takeda et al., 1990). Time, money, and information are often resources that run out, without the designer being pleased with the solution. The design process can even be viewed as something continuous rather than something that is done over a certain period of time (Lawson, 2006).

In a design experiment Takeda et al., (1990) examined the design process from a problem-solving perspective and analyzed how designers reason during a design cycle. The designers were videotaped while designing an artifact from a given set of specifications. Everything the designers did and said during the experiment was analyzed and resulted in a cognitive model of design processes. The cognitive model consisted of five sub-processes: (1) awareness of the problem, (2) suggestion, (3) development, (4) evaluation, and (5) conclusion (Figure 7).

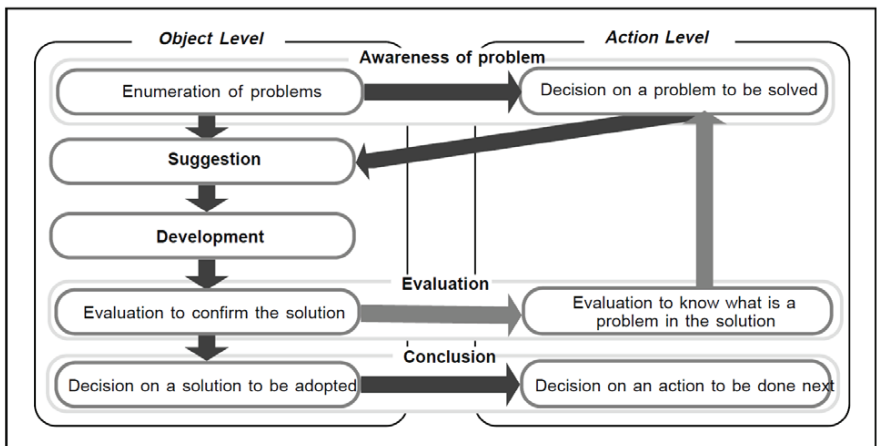


Figure 7. Design Cycle (Takeda et al., 1990)

In the awareness of the problem phase the designer found problems while comparing the object that was being designed with the specifications. In the suggestion phase key concepts that were needed to solve the problem were identified and suggested. These concepts were then used to develop candidates for the problem in the development phase. During the evaluation phase the developed candidates were evaluated in different ways. In the conclusion phase it was decided what candidate to adopt as a solution to the problem. (Takeda et al., 1990)

Essentially one single design cycle solves one single problem, and if new problems arise that need to be addressed during the process, then these problems should be solved in other design cycles. Takeda et al., (1990) also distinguish between two levels considering how the designer reasons. The object level where the designer thinks about the object itself and its properties, e.g. how it behaves in different circumstances. The other level is the action level where the designer reasons about what the next step of action should be.

5.4 Science and Research

Simplified, research can be described as an activity that aims at contributing to the understanding of a certain phenomenon (Vaishnavi and Kuechler, 2008). There are different ways of obtaining an understanding of a phenomenon, and the way in which a research process is carried out is reflected and influenced by the underlying research philosophy chosen by the researcher. There are two major paradigms or philosophical positions in the social sciences that debate the methods for conducting research: the phenomenological/interpretive tradition and positivism (Easterby-Smith et al., 2008).

Positivists believe that the world, and within social sciences the social world, exists externally and should be measured through objective methods. This implies that reality is external and objective and that knowledge should be based on observations of this external reality in order to be a contribution (Easterby-Smith et al., 2008). Springing from the natural sciences the quantitative approach was designed to study natural phenomena (Myers, 2009). The idea is that quantitative data or numbers represent the values and levels of the constructs and concepts at study and that the

interpretation of these is seen as strong evidence of how the studied phenomena work (Straub et al., 2004). Common methods within the natural sciences include surveys and laboratory experiments with the use of statistical tools to analyze data.

Interpretivism is a reaction to the positivistic approach to social science studies. The interpretive view is that reality is not objective and exterior. Rather reality is socially constructed and being interpreted and given meaning by people (Easterby-Smith et al., 2008). The interpretation of reality also means that the researcher cannot avoid affecting the phenomena of study. Examples of qualitative methods used within the interpretive paradigm are action research, case study research and ethnography (Myers, 2009) and foundations for empirical data include interviews, participant observations, and documents (Denzin and Lincoln, 2003; Myers, 2009). Examples of documents that can form the empirical data are e-mails or reports from e.g. a learning management systems (Myers, 2009).

IS research using the interpretive tradition is more concerned with the organizational setting and the consequences of technology than the developmental process (Gregg et al., 2001). On the other hand, the positivist tradition considers (new) technology as either present or absent, and the system development process is not considered as a part of the fuller understanding of creating scientific knowledge (Gregg et al., 2001). In a call to bring design activity into focus, Simon (1996) made a distinction between natural science and the science of the artificial. The next section describes the history of design oriented research and design science research.

5.5 Design oriented research

Simon (1996) is often credited with beginning the discussion about design as a science. In his book *The Science of the Artificial*, first published in 1969, he distinguished between exploratory/traditional science and the sciences of the artificial, i.e. how to design artifacts. Simon (1996) viewed the design of artifacts as an intervention and stated “Everyone designs who devises courses of action aimed at changing existing situations into preferred ones” (Simon, 1988, p. 129).

Simon (1996) describes how the sciences of the artificial, later referred to as design science, had been driven from the curriculum of the schools to make room for natural sciences in the late nineteen sixties and early nineteen seventies. This movement away from the sciences of the artificial was most significant in engineering, business, and medicine (Simon, 1996). At the same time a tradition of design-oriented research started in Scandinavia. It started in the early nineteen seventies with the Scandinavian unions wanting more influence over the new technologies that were being introduced in the workplace (Bansler, 1989). To begin with, the unions had little knowledge about computers and the consequences of computing technologies being used in the workplace. To address this knowledge gap, several large projects were initiated (e.g. DEMOS and UTOPIA) studying the impact and effect that computers had on everyday work (Bansler, 1989). DEMOS involved four different enterprises (a repair shop, a newspaper, a metal factory, and a department store) using an action research method where workers investigated the conditions of their technology infused workplaces based on their own experience and competence (Ehn, 1988). Researchers took part in the project as resource persons, contributing with their time and academic knowledge (Ehn, 1988).

Practical work aiming at changing the work practice is combined with the systematic collection and analysis of data aiming at intervention (Spinuzzi, 2005) is what characterized these early projects. Additionally, a central idea was not only to contribute to research, but also to share the results and the experiences with workers and other workplaces. In DEMOS this meant writing textbooks and other educational material for workers on how to use computers from a work perspective (Ehn, 1988). Out of these and other similar projects the participatory design movement grew (Steen et al., 2007; Spinuzzi, 2005), focusing on the involvement of the end-users of a system early in the design process and also in the evaluation and implementation of the system (Spinuzzi, 2005).

In nineteen ninety Takeda et al., (1990) wanted to develop a model to support the development of Computer-Aided Design (CAD) systems. The design cycle model consisted of five sub-processes: (1) awareness of the problem, (2) suggestion, (3) development, (4) evaluation, and (5) conclusion (Takeda et al., 1990). This design cycle was later used by Vaishnavi and Kuechler (2008) when developing a method for DSR. During the same period Nunamaker et al., (1990) presented a framework for using systems development as a methodology in IS research. Nunamaker et al., (1991) argued that systems development and the testing and evaluation of systems under development very well could result in research contributions. Although Nunamaker et al. (1991) did not reference Simon (1996) or call it design science, it is a clear contribution to design science (Venable, 2006).

Walls et al., (1992) addressed Simon's (1996) call for a science of the artificial when they presented a model for creating IS design theories. Walls et al., (1992) listed seven characteristics that distinguished design theories, and proposed that IS design theories should be prescriptive so they could be used for solving practical problems.

Markus et al., (2002) later furthered the work of Walls et al., (1992) proposing that IS design theories could be a set of user requirements derived from kernel theory, principles for the development process, and principles supporting the design of a system (Markus et al., 2002). March and Smith (1995) also refer to Simon (1996) and address that real problems must be conceptualized, followed by the construction of a solution that is implemented and evaluated. After the evaluation the researcher should theorize and justify (March and Smith, 1995).

In 2001 Orlikowski and Iacono (2001) wrote a call for research paper, seeking the IT artifact in IS research. Orlikowski and Iacono (2001) did not mention design science, but pointed to the need for giving theoretical significance to the artifact and not only its context, capabilities or the consequences of use. The artifact is meant to solve specific problems for certain situations, but design science research should also generate a solution for a class of problems (van Aken, 2004). This generalization for a class of problems is meant to be used by both researchers and practitioners to solve other problems from the same class. This dual use of DSR results are what Hevner et al., (2004) call rigor and relevance. Rigor refers to the validity and reliability of the result and should be considered to contribute to the knowledge base. Relevance refers to practitioners being able to use the results to solve real problems (Hevner et al., 2004). Hevner et al., (2004) also proceed to define seven criteria that will guide researchers doing DSR. Venable (2006) also stresses the importance of both relevance and rigor, and states that design theories should make utility claims, e.g. creating a system according to the prescribed design specifications and designing a process that will have a useful result.

In 2007 Gregor and Jones (2007) extend the specification of Walls et al., (1992) addressing what Gregor and Jones (2007) found as weaknesses in the model for

creating design theories presented by Walls et al., (1992). Gregor and Jones (2007) conclude that a design theory should include as a minimum six core components with two additional non-mandatory components. Even though a design theory is the desired form, a general well-developed design theory or grand theory is a time consuming joint effort by the research community of the specific area and is a less likely outcome of DSR at this point in time (Chatterjee, 2015; Vaishnavi and Kuechler, 2015). It is more likely that the outcome of a DSR project is a nascent design theory (Gregor and Hevner, 2013) in the form of constructs, methods, models design principles or technological rules. Gregor and Hevner (2013) place grand theory at the highest of three levels of DSR contributions and nascent design theories at the second level. At the first level of DSR contribution types Gregor and Hevner (2013) place situated implementation of an artifact, e.g. an instantiation in the form of a software product.

In later years the contributions to the methodology of design science research has increased, addressing the lack of discussion within the field on how to conduct design science research. Some of the literature would present process models for the entire design science research process (Peppers et al., 2007; Baskerville et al., 2009; Sein et al., 2011) while others focused on certain parts of the design science process (Venable et al., 2014; Lukyanenko et al., 2015). As shown in the table below, much of the discussion on DSR has concerned either theory building or method development. Another strand of the discussion on DSR concerns the differences and similarities between action research and design science (Cole et al., 2005; Järvinen, 2007; Iivari and Venable, 2009). According to Cole et al., (2005) and Järvinen (2007), the similarities are so great between the two research approaches that we cannot separate them from each other. Iivari and Venable (2009) on the other hand point to the differences between action research and design

science. Some researchers merge design science research and action research, e.g. soft design science methodology (Baskerville et al., 2009) and action design research (Sein et al., 2011). Baskerville et al., (2009) state that by merging the common design science research process of “design, build-artifact, and evaluation” together with the iterative soft systems methodology, a better understanding of the problem is gained. Sein et al., (2011) address the problem of traditional design science research not recognizing the impact of the organizational context on the development of IT artifacts by incorporating action research into design science research.

Type of contribution	Examples of articles
Theory	Walls et al., 1992; March and Smith, 1995; Orlikowski and Iacono, 2001; Markus et al., 2002; van Aken, 2004; Venable, 2006; Gregor and Jones, 2007; Gregor and Hevner, 2013
Method	Takeda et al., 1990; Nunamaker, et al., 1991; Hevner et al., 2004; Peffers et al., 2008; Baskerville et al., 2009; Sein et al., 2011; Venable et al., 2014

Table 19. Examples of articles contributing to a theory or method

The wish to scientize design can be traced back to the modern movement of design from the 1920’s and the desire to produce art and design that were based on objectivity and rationality, i.e. on scientific values (Cross, 2001). Even so, the earliest reference made by most researchers involved in design science is to Simons (1996) book *The Sciences of the Artificial* (Winter, 2008), so it is fair to say that design science as a paradigm is new. There are ongoing discussions about what design science is and is not (e.g. Winter, 2008; Gregor and Hevner, 2013) and as illustrated above there has been many contributions to knowledge creation and

methodology (see table 19). In the next chapter a collection of these research contributions to design science research will be described in more detail.

5.6 Design Science Research

As mentioned above, some of the early influential articles in terms of defining what design science research is were written by Walls et al., (1992), March and Smith (1995), and Hevner et al., (2004). These articles along with more recent contributions on what design science research is and is not will be discussed and summarized in the following sections. Walls et al., (1992 p. 37) define design theory as “prescriptive theory based on theoretical underpinnings which says how a design process can be carried out in a way which is both effective and feasible”. Walls et al., (1992) further define design theory as consisting of two dependent aspects, one dealing with the product (see the left row in figure 8) and one dealing with the process (see the right row in figure 8). Both should be rooted in a kernel theory from which meta-requirements and a meta-design are derived that is applicable to an entire class of problems. This results in a hypothesis that is used to test and verify the meta-design against the meta-requirements on the product side and design method against the meta-design on the process side.

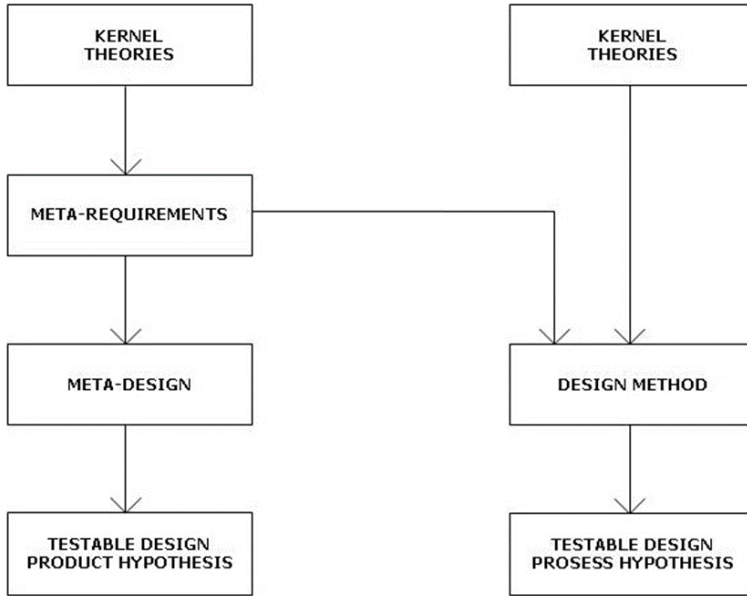


Figure 8. Components of an Information System Design Theory (Walls et al., 1992)

Gregor and Hevner (2013) present a knowledge contribution framework for design science research to help position the contributions of a design science research project (Figure 9). The framework has four dimensions with a solution maturity from high to low on one axis and application domain maturity on the other axis, also from high to low. This gives four types of knowledge contributions: improvement, invention, routine design and exaptation. An improvement is a new solution to an already known problem, whereas invention is a new solution to a new problem. Routine design is simply applying an existing solution to a known problem and is not considered to be a high knowledge contribution. However, if a known solution, e.g. from another field or domain, is applied to a new problem then that exaptation is considered to be a knowledge contribution.

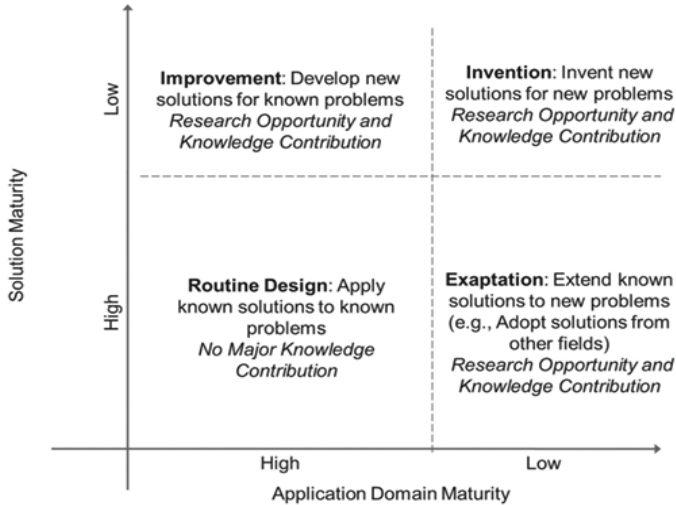


Figure 9. DSR Knowledge Contribution Framework (Gregor and Hevner, 2013)

Since the realm of IS research is at the crossroads of people, organizations and technology, behavioral science also plays an important role when doing research within the IS discipline (March and Smith, 1995; Hevner et al., 2004). Both the design science and the behavioral science paradigms are needed to ensure both rigor and relevance of the research. The behavioral science paradigm springs from natural science research methods and develops theories to explain or predict organizational and human phenomena surrounding the analysis, design, implementation, management, and use of information systems. These theories impact and are impacted by the design process, i.e. development methods used, functionality, information content and the human interfaces, hence both paradigms are needed and inform each other.

At the core of design science are the developing/building and justifying/evaluating cycles, which are preceded by a problem identification phase (Hevner et al., 2004; Vaishnavy and Kuechler, 2007). The result of the cycle may refine the artifact/system and if so the system is tested again until the system is ready for implementation and new knowledge can be gained from the artifact and the process that then should be added to the knowledge base. There are then two outcomes of design science: knowledge contribution and the designed artifact.

Hevner et al., (2004) provide a set of seven guidelines that help information systems researchers conduct, evaluate and present design science research. The seven guidelines address design as an artifact, problem relevance, research rigor, design as a search process, design evaluation, research contributions, and research communication. The first guideline addresses design as an artifact. Design-science research must produce a purposeful artifact that addresses an organizational problem of importance. This artifact could be in the form of a construct, a model, a method, or an instantiation. These artifacts must add some novelty to the context where it is applied (Hevner et al., 2004).

The second guideline describes problem relevance. The goal of design-science research is to develop and evaluate solutions in a real-world context. The third guideline describes the importance of using rigorous methods for evaluating the design. Since design inherently is an iterative process, the evaluation phase should provide feedback to the construction phase. The iteration is carried out until the design of the artifact solves the initial problem. The fourth guideline addresses the importance of the work being considered as a contribution to the academic world. Designing a problem-solving artifact is not enough, and the outcome also needs to be an addition to the knowledge base of the field (Hevner et al., 2004).

The fifth guideline focuses on research rigor and the way the research is conducted. Success is dependent upon choosing appropriate theories for the creation of the artifact and research methodologies for the evaluation. The sixth guideline relates to design as a search process. Design seen as a process is essentially a search process to find an effective solution to a problem. This requires knowledge of both the application domain and the solution domain. The last guideline concerns the communication of research. Design science research must be communicated and presented in a way that both technology-oriented and management-oriented audiences understand. Technology-oriented audiences must be able to understand how the artifact was created and evaluated, whereas management-oriented audiences should be able to determine if it is cost effective to construct or buy the artifact (Hevner et al., 2004).

A common and relevant way of communicating the design science research results are through design principles (Gregor and Jones, 2007; Gregor and Hevner, 2013). According to Sein et al., (2011), design principles should not only be the knowledge gained from building and evaluating a solution for a specific domain but rather “encompass knowledge about creating other instances that belong to this class” (Sein et al., 2011, p. 45). Gregor and Jones (2007) suggests using testable propositions or hypotheses about the system, e.g. as formulated by Aken (2004) “If you want to achieve Y in a situation Z, then something like action X will help” (Aken, 2004, p. 227). Although examples of outcomes articulated as design principles (e.g. Lindgren et al., 2004; Markus et al., 2002; Walls et al. 1992) there is no consensus as to how these design principles should be formulated and structured (Chandra et al., 2015). The validity of an artifact can be measured by how well a design principle transfers to the instantiation and the activity of the user group

(Chandra et al., 2015) which points to the importance of clarity when formulating design principles. Hence Chandra et al., (2015, p 4045) suggests design principles to have the following structure: “Provide the system with [material property—in terms of form and function] in order for users to [activity of user/group of users—in terms of action], given that [boundary conditions—user group’s characteristics or implementation settings]”. Materiality refers to how the artifact should be designed and action is what can be done with the artifact. Boundary conditions could here been seen as a description of the class of problems the design principles apply to.

Venable et al., (2014) provide a framework for how to choose evaluation method. Depending on the type of project and the goal of the evaluation, different evaluation strategies and methods are suggested. These evaluation strategies and suggested methods are outlined in figure 10 and 11, presented in a publication (Venable et al., 2012) preceding the 2014 paper. The strategies differs depending on whether the evaluation should be *ex ante*, i.e. formative before the instantiation of the artifact, or *ex post*, i.e. summative after the instantiation of the artifact. Whether or not the setting is artificial i.e. outside the intended context of use or in a naturalistic setting with a real system and real users also inform the selection of strategy (see figure 10).

DSR Evaluation Strategy Selection Framework		Ex Ante	Ex Post
		<ul style="list-style-type: none"> •Formative •Lower build cost •Faster •Evaluate design, partial prototype, or full prototype •Less risk to participants (during evaluation) •Higher risk of false positive 	<ul style="list-style-type: none"> •Summative •Higher build cost •Slower •Evaluate instantiation •Higher risk to participants (during evaluation) •Lower risk of false positive
Naturalistic	<ul style="list-style-type: none"> •Many diverse stakeholders •Substantial conflict •Socio-technical artifacts •Higher cost •Longer time - slower •Organizational access needed •Artifact effectiveness evaluation •Desired Rigor: "Proof of the Pudding" •Higher risk to participants •Lower risk of false positive – safety critical systems 	<ul style="list-style-type: none"> •Real users, real problem, and somewhat unreal system •Low-medium cost •Medium speed •Low risk to participants •Higher risk of false positive 	<ul style="list-style-type: none"> •Real users, real problem, and real system •Highest Cost •Highest risk to participants •Best evaluation of effectiveness •Identification of side effects •Lowest risk of false positive – safety critical systems
Artificial	<ul style="list-style-type: none"> •Few similar stakeholders •Little or no conflict •Purely technical artifacts •Lower cost •Less time - faster •Desired Rigor: Control of Variables •Artifact efficacy evaluation •Less risk during evaluation •Higher risk of false positive 	<ul style="list-style-type: none"> •Unreal Users, Problem, and/or System •Lowest Cost •Fastest •Lowest risk to participants •Highest risk of false positive re. effectiveness 	<ul style="list-style-type: none"> •Real system, unreal problem and possibly unreal users •Medium-high cost •Medium speed •Low-medium risk to participants

Figure 10: A design science research evaluation strategy selection framework (Venable et al., 2012, p. 10)

The dimensions naturalistic vs. artificial and ex ante vs. ex post are also choosing a method it should be considered whether the evaluation should be naturalistic, i.e. real users using a real implemented system solving real tasks, or artificial, i.e. one or more of either real users, real system or real tasks are missing from what is being evaluated, see figure 11 (Venable et al., 2012).

DSR Evaluation Method Selection Framework	Ex Ante	Ex Post
Naturalistic	<ul style="list-style-type: none"> •Action Research •Focus Group 	<ul style="list-style-type: none"> •Action Research •Case Study •Focus Group •Participant Observation •Ethnography •Phenomenology •Survey (qualitative or quantitative)
Artificial	<ul style="list-style-type: none"> •Mathematical or Logical Proof •Criteria-Based Evaluation •Lab Experiment •Computer Simulation 	<ul style="list-style-type: none"> •Mathematical or Logical Proof •Lab Experiment •Role Playing Simulation •Computer Simulation •Field Experiment

Figure 11: A design science research evaluation method selection framework (Venable et al., 2012, p. 11)

Many of the design research approaches (e.g. Hevner et al., 2004; March and Smith, 1995) emphasize the central role of the artifact in contrast to Walls et al., (1992), where the artifact is used to test a design theory (Gregor and Jones, 2007). Going back to the article by Walls et al., (1992), Gregor and Jones (2007) identify four weaknesses in their specification of information systems design theories (ISDT):

- A lack of clarity as to what ISDT concerns, whether it is a product or process or necessarily both.
- The omission of the mandatory “units” (constructs) and “system states” in the adaptation of Dubin’s specification of theory components.
- A lack of consideration of the importance of a design instantiation, as stressed in the design science literature, except as a test of a theory.
- A possibly unnecessary distinction between kernel theories for design processes and kernel theories for design products (Gregor and Jones, 2007).

To address these weaknesses, Gregor and Jones (2007) extend the specification of Walls et al., (1992) and suggest that a design theory should include as a minimum six core components. They also add two additional components. The six core components and the two additional components are:

Component	Description
Core components	
1) Purpose and scope	“What the system is for”, the set of meta-requirements or goals that specifies the type of artifact to which the theory applies and in conjunction also defines the scope, or boundaries, of the theory.
2) Constructs	A definition of the entities of interest in the theory
3) Principle of form and function	The abstract “blueprint” or architecture that describes an IS artifact, either product or method/intervention.
4) Artifact mutability	The changes in state of the artifact anticipated in the theory, that is, what degree of artifact change is encompassed by the theory.
5) Testable propositions	Truth statements about the design theory.
6) Justificatory knowledge	The underlying knowledge or theory from the natural or social or design sciences that gives a basis for the design (kernel theories).
Additional components	
7) Principles of implementation	A description of processes for implementing the theory (either product or method) in specific contexts.
8) Expository instantiation	A physical implementation of the artifact that can assist in representing the theory both as an expository device and for purposes of testing.

Table 20. Eight components of an Information Systems Design Theory (Gregor and Jones, 2007)

Purpose and scope state “what the system is for” i.e. the meta-requirements (i.e. not the requirements of merely one instance of a system) or goal of the type of system to which the theory applies and the boundaries of the theory. The artifact requirements should be described with regards to the context in which it is to operate. The constructs, which are the concepts of interest, or as Gregor and Jones (2007) put it, entities that can be physical phenomena or abstract theoretical terms, should be defined as clearly as possible.

The principle of form and function components concerns the principles that make up the structure, organization, and functioning of the design. If it is a design product then the shape of the product is seen in the properties, functions, features, or attributes of the product when constructed (e.g. a word processor should have file and text manipulation features and explain how they interrelate). If it is a design method then the principles would, in a generalized form, show the shape and features of the method (e.g. the waterfall model of the systems development life cycle).

Artifact mutability refers to the need to reflect upon and deal with the changing nature of artifacts. Specifying the degree of mutability of the designed artifact could be done through a specification of different states of physical systems. It could also go further and deal with how changes affect the basic form and shape of the artifact by e.g. allowing for a certain amount of adaptability or evolution. In order to do this, a system needs to be tested and testable against the stated objectives and requirements.

Justificatory knowledge is what Walls et al., (1992) refer to as kernel theories, although Walls et al., saw the kernel theories as informing the design product and

the design process separately, whereas Gregor and Jones (2007) argue that these theories link all or at least a number of the design theory aspects. In contrast to Venable (2006), Gregor and Jones (2007) argue that justificatory knowledge is a necessary component of ISDT even though Gregor and Jones (2007) agree with Simon (1996) that it is possible to have an incomplete understanding of the theories to build a design theory as long as we understand the parts that are crucial to the design theory.

This component of principles of implementation concerns the process of implementation, i.e. the means by which the design product or the design process is brought into being. Principles of implementation could also be provided by a generic implementation method such as Sommerville's (2004) four steps of prototyping: (i) establish prototype objectives, (ii) define prototype functionality, (iii) develop prototype, and (iv) evaluate prototype. Another example is the general methodology of design research (Vaishnavi and Kuechler, 2008).

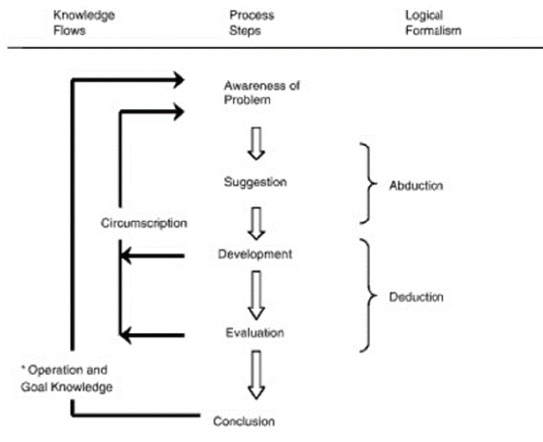


Figure 12. Reasoning in the general design cycle (Vaishnavi and Kuechler, 2008)

New knowledge is represented by the arrows circumscription and operation and goal knowledge.

For the purpose of theory representation and theory testing, Gregor and Jones (2007) argue for an expository instantiation as a possible component in an ISDT. An instantiation could e.g. be a system, although Gregor and Jones (2007) do not take a stand on whether a component of a theory could be an instantiation or not.

In the aforementioned design science research approaches, a basic research process consists of formulating hypotheses in the form of a design, conducting an experiment by implementing the designed artifact, and evaluating and validating if the result of the evaluation matches the expectations of the implemented artifact. Kasanen et al., (1993) suggest that developed artifacts can be validated through a market test, being a weak, semi-strong or strong market test. A weak market test has a manager willing to apply the construction or artifact to the actual decision making of a problem (Kasanen et al., 1993). It is a semi-strong market test if the artifact has become widely adopted across companies (Kasanen et al., 1993). Finally, it is a strong market test if the business units applying the artifact have better financial results than those business units which are not using the artifact (Kasanen et al., 1993). These market tests also help verify if the artifact is applicable to a class of problems (Kasanen et al., 1993).

In later years there has been efforts stressing that design science research does not need to be set up as a traditional experiment (Sein et al., 2011; Baskerville et al., 2009). Baskerville et al., (2009) state that by merging the common design science research process of “design, build-artifact, and evaluation” together with the

iterative soft systems methodology, a better understanding of the problem is gained. Sein et al., (2011) address the problem of traditional design science research not recognizing the impact of the organizational context on the development of IT artifacts by incorporating action research into design science research. This action design research framework (Sein et al., 2011) is presented in the following sections.

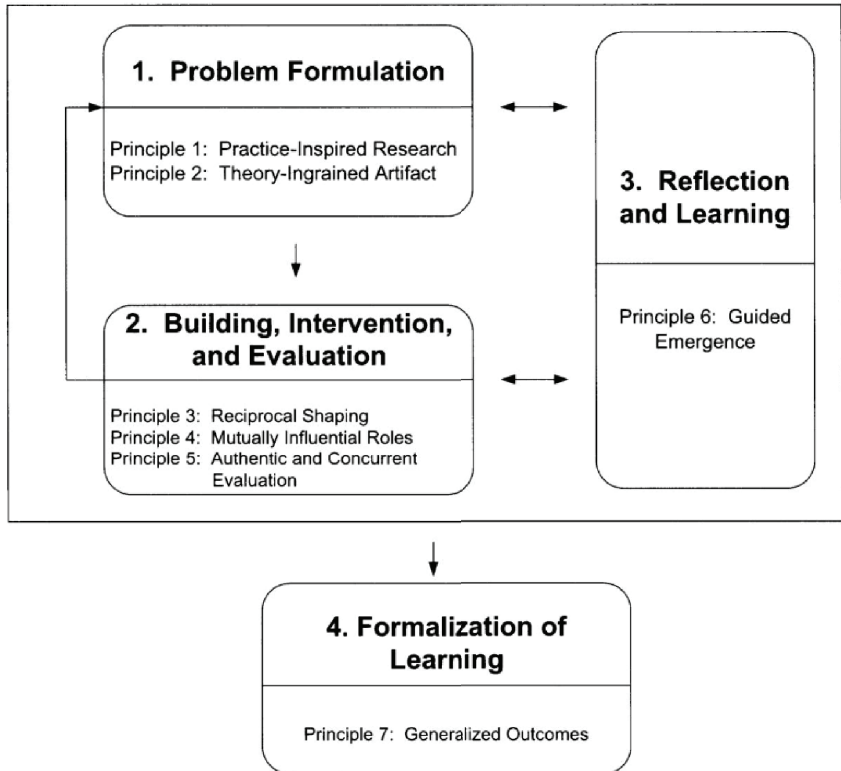


Figure 13. ADR Method: Stages and Principles (Sein et al., 2011)

The action design research framework (Sein et al., 2011) consists of 4 stages with a total of 7 principles. The first stage is problem formulation, which can be provided

by practitioners, end-users, the researchers, existing technologies, and/or a literature review of prior research. The first principle of this stage is called practice-inspired research, which states that the intention of action design research should be to generate knowledge that applies to the class of problems that the problem of the research addresses. Next, the principle of theory-ingrained artifact stresses that the artifacts that are to be created and then evaluated should be informed by theories. This stage is hence used to identify contributing theories and prior technological advances. Sein et al., (2011) use the taxonomy of Gregor (2006) when referring to types of theory that are likely candidates for action research design namely: type 4, theory for explaining and predicting, and type 5, theory for design and action. A theory then informs the creation of an initial artifact. The initial artifact created in this stage then forms the basis for cycles of intervention, evaluation, and further redesign in the following stages.

Stage 2 in the action design research framework (Sein et al., 2011) consists of building, intervention, and evaluation. Based on the theory chosen in the previous stage the IT artifact will be developed. The IT artifact is then re-designed by iterative design cycles of: building of the IT artifact, intervention in the organization, and evaluating it in the target organization. The result of this build, intervention and evaluation (BIE) stage is the finalized artifact. BIE can be on a continuum with IT-dominant BIE on one end and organization-dominant BIE at the other end. IT-dominant BIE aims at creating an innovative technological design e.g. by letting early designs intervene in a limited organizational context. The artifact and its built-in theories then emerges through testing against users' assumptions, expectations, and knowledge leading to new instantiations that are tested again. Building on these cycles of interactions, a more mature artifact will emerge that can be taken into a

wider organizational setting and may result in the exit of the researchers or start of a new BIE cycle.

Organization-dominant BIE aims at generating design knowledge through organizational intervention. This is done by challenging the employees' ideas and assumptions about an artifact's specific use context in order to create and improve the design of the artifact. Each iteration ends with an evaluation of the artifact and the design principles embedded in the artifact. The iterations are repeated until the organization adopts/rejects the artifact or until it is deemed that further iterations will contribute very little to the improvement of the artifact. Within the BIE stage there are three principles: principle 3, reciprocal shaping principle 4, mutually influential roles, and principle 5, authentic and concurrent evaluation.

The principle of reciprocal shaping emphasizes how the IT-artifact and the organizational context influence each other. The design of the artifact will shape the organizational environment and the gained understanding of the organization that each iteration gives, will inform the design of the artifact. Mutually influential roles, the fourth principle, stresses the importance of sharing knowledge and enabling all the participants to learn from the project. The action design researchers bring knowledge in the form of theories and technological advances whereas the practitioners bring knowledge of organizational work practices. The fifth and last principle of stage 2 is the principle of authentic and concurrent evaluation, emphasizing that evaluation is not something you do in a separate stage at the end of designing and building. The evaluation should be constantly ongoing and decisions about re-design could occur at any time.

The last two stages consist of one principle each. Stage 3, reflection and learning draws on the principle guided emergence and stage 4, formalization of learning draws on the principle of generalized outcomes. The role of the 3rd stage is to make the ADR team aware of constantly ongoing refinement of the artifact is not only reflected by the intermediate design. The artifact will also reflect the shaping by organizational use, perspectives, and participants as well as the constantly ongoing evaluation. The last stage emphasize that, in parallel with the above described stages 1 and 2, the learning that takes place through constant reflection throughout the process is to be applied to a broader class of problems.

5.7 Summary and choice of methodological approach

If any kind of designer chooses a scientific approach and process to designing, it will limit what and how things can be done and the eventual outcome itself (Nelson and Stolterman, 2012). IS design science puts a greater focus on the design research process (Winter, 2008), which makes design science research a less limiting approach and well suited for answering the design-oriented research question put forward in this thesis. In the following sections the different design science approaches are discussed and concluded with a motivation for choosing design science research as a methodological approach.

One thing all design science research theories and frameworks have in common is that the artifact construction should be rooted in a kernel theory. Sein et al., (2011) state in their second principle that the artifacts created should be informed by theories. Gregor and Jones, (2007) call it justificatory knowledge and give it a

broader meaning by also including informal knowledge and experience from practitioners in the term justificatory knowledge. The methods used should also be rooted in a kernel theory. Walls et al., (1992) visualize this in their model Components of an Information System Design Theory (see figure 9) with having one kernel theory pointing to the meta-requirements and one kernel theory pointing to the design method. Hevner et al., (2004) similarly state that theoretical foundations and research methodologies are required in both the construction and evaluation of the designed artifact. Although there are attempts to develop a design science research methodology (e.g. Peffers et al., 2007; Venable et al., 2014), there is no commonly accepted way of conducting design science research in terms of specific techniques and methods.

Other aspects linking the design science research theories and frameworks together are the stages of the research process such as problem formulation, suggestion for a solution to that problem, designing and developing the solution and evaluation of the artifact instantiation (e.g. March and Smith, 1995; Hevner et al., 2004; Vaishnavi and Kuechler, 2008). As of late there has also been a growing discussion on how to present the result from the design science research activities (Gregor and Hevner, 2013). All these elements are represented in an article by Peffers et al., (2007) attempting to create a commonly accepted methodological framework for design science research. Based on a review of seven representative papers within design science, Peffers et al., (2007) present a design science research methodology that includes six steps: problem identification and motivation, definition of the objectives or a solution, design and development, demonstration, evaluation, and communication of the design knowledge (Peffers et al., 2007). One way to communicate the design knowledge is through design principles (Gregor and Hevner, 2013).

Design science research was chosen for this PhD-project mainly because e-learning and e-training are complex problems that not only involve two different stakeholders among the learners/employees and the organization/management, but also needs to address the pedagogical aspect. Design science research states that the design and creation of artifacts should be informed by theories, in the case of e-learning and e-training more specifically pedagogical theories. This complexity calls for flexibility in the research process. Therefore, the general design cycle (Vaishnavi and Kuechler, 2008) was chosen to guide the research process on an overarching level, since it gave the option of circumscription at any stage in the process.

Given the context of e-training, it is important that the outcome of the research activity not only contributes to the research domain of e-training, but also has the potential of being relevant to practice. The result of a design science research project should be presented in a way that technicians understand how the artifact was created and evaluated and thereby knows how to use that in their own practice. In a similar way management should be able to evaluate if it is cost effective (Hevner et al., 2004). Properly formulated design principles convey the outcome of an outcome of a design science research project in a clear and precise way (Chandra et al., 2015). Although not available at the time of designing the research process, the research process of this thesis resembles the action design research process (Sein et al., 2011) in that the context affects the IT artifact during development and use and thereby affects the emergent knowledge contribution. The evaluation activities in the design science research cycles influenced and informed the design in the following design science research cycle as described by Ihlström et al., (2011).

5.8 Data collection methods

When collecting data an issue is the overall research design. Should the case solely rely on the data from a survey or are there other sources of data to validate or strengthen the findings? Lee and Heller (1997) made a study where they used keystroke log files to evaluate an interactive information kiosk in a museum. They found that users rely greatly on the online help in the system during the interaction with the kiosk, but they only speculate upon the reasons for that, since they did not ask the users through e.g. a survey or interview. Lee and Heller (1997) themselves state that in order to gain a better understanding they should have asked the users some questions, one way or the other. This study used interviews, surveys and web server logs in order to get a deeper understanding of the users' interaction with the web lecture application.

Overview of data collection methods	
WLA	Data collection
1 st version of Search the WWW	<ul style="list-style-type: none">• Workshop with representatives from IT-department• Run trials of WLA prototype
2 nd version of Search the WWW	<ul style="list-style-type: none">• 1 face-to-face interview• Questionnaire with 15 respondents• Log data
3 rd version of Search the WWW	<ul style="list-style-type: none">• 9 phone interviews• Questionnaire with 11 respondents• Log data
Introduction to new IT milieu	<ul style="list-style-type: none">• 18 face-to-face interviews

Table 21. Overview of data collection methods

The interviews were semi-structured face-to-face and phone interviews. The county administration has a tradition of phone meetings, so doing some of the interviews over the phone was not deemed a problem by either the author or the contact person at the county administration. For the interview guide see the appendix. The interview process was guided by the four-step method of inquiry by McCracken (1988):

1. Review of analytic categories and interview design, which means reviewing the literature and previous research in this field to be able to define problems and assure that the research will contribute to the body of research. Furthermore, it helps construct a relevant interview guide.
2. Review of cultural categories and interview design. This step aims at engaging the investigator in two processes: familiarization and defamiliarization by first trying to identify cultural categories and relationships that exist in the object of study. Then the researcher needs a critical distance from the object of study.
3. Interview procedure. Doing the interviews in a relaxed atmosphere and phrasing the questions in a nondirective manner so the interviewer does not put words in the interviewee's mouth.
4. Interview analysis and the discovery of analytical categories. Analyzing the interviews and trying to point out patterns and if possible, categorize them.

The literature review in the initial problem identification phase also served as a base for the interviews and the interview design as the first step in McCracken's (1988) four-step method of inquiry. The second step was achieved in the interaction with the management of the county academy administration. Through meetings and workshops with representatives from the county administration and participation in the board meetings of the academy of county administrations, the author developed

a perception of the organizational culture of the county administration. The management of the county academy administration also gave feedback on the formulation of the interview questions in order to reduce the risk of misinterpretation.

The third step in the four-step method of inquiry (McCrackens, 1988) is the execution of the interviews. These were done either over the phone or at the office of the interviewee. In both cases the interviewees answered the questions in a place that was familiar to them and thereby good conditions for a relaxed atmosphere were created (McCrackens, 1988). The interview was set up as a conversation between the interviewer and respondent, as a way of preventing the interviewees from guessing what kind of answers the interviewer was looking for by. This was also strengthened by the use of open-ended questions (for all interview questions see appendix). To get the interviews going they all started by the interviewer asking the interviewee to describe a typical working day (Easterby-Smith et al., 2008). This was a question the interviewee easily could answer and got the interview off to a relaxed start. The interviews were semi-structured, i.e. the interviewee had control over the order of questions/topics and the author followed the interviewee's lead. The author made sure that at the end of the interview all questions had been answered.

The final step in the four-step method of inquiry (McCrackens, 1988) is the analysis. The interviews were transcribed and Atlas.TI was used to markup the interviews in order to find patterns that could be categorized. This is described in more detail in chapter 7.4.

In order to further evaluate the use and interaction, web logs from the interaction with the WLA were carefully analyzed. The web lecture application was running on an Internet Information Server on which a log file was created each day. The web server was configured so that the IP-addresses originating from domains at University West were not logged, so the author could surf to the pages without interfering with the analysis of the web logs. In that way the author could access the WLA, e.g. to get screen dumps or to demonstrate locally, without having to clean the logs from entries from IP-addresses belonging to University West. The web log files that were created every day were text files and were compiled with Nihuo Web Log Analyzer. The below figure illustrates an example of a web log:

```
#Software: Microsoft Internet Information Services 6.0
#Version: 1.0
#Date: 2008-03-12 07:49:20
#Fields: date time cs-method cs-uri-stem cs-uri-query cs-username c-ip cs-version cs(User-
Agent) cs(Referer) sc-status sc-bytes cs-bytes
2008-03-12 07:49:20 GET /soka/main.html - - 212.3.12.1 HTTP/1.0
Mozilla/4.0+(compatible;+MSIE+6.0;+Windows+NT+5.1;+SV1;+.NET+CLR+1.1.4322;+.NET+
CLR+2.0.50727) http://www.ostlund.stream.hv.se/soka/ 304 235 637
2008-03-12 07:49:20 GET /soka/main.html - - 212.3.12.1 HTTP/1.0
Mozilla/4.0+(compatible;+MSIE+6.0;+Windows+NT+5.1;+SV1;+.NET+CLR+1.1.4322;+.NET+
CLR+2.0.50727) http://www.ostlund.stream.hv.se/soka/main.html 304 235 463
2008-03-12 07:49:58 GET /soka/idxMejl.html - - 212.3.12.1 HTTP/1.0
Mozilla/4.0+(compatible;+MSIE+6.0;+Windows+NT+5.1;+SV1;+.NET+CLR+1.1.4322;+.NET+
CLR+2.0.50727) http://www.ostlund.stream.hv.se/soka/navKurs.html 200 590 566
2008-03-12 07:49:58 GET /soka/navMejl.html - - 212.3.12.1 HTTP/1.0
Mozilla/4.0+(compatible;+MSIE+6.0;+Windows+NT+5.1;+SV1;+.NET+CLR+1.1.4322;+.NET+
CLR+2.0.50727) http://www.ostlund.stream.hv.se/soka/idxMejl.html 200 1653 566
2008-03-12 07:49:58 GET /soka/mejlMain.html - - 212.3.12.1 HTTP/1.0
Mozilla/4.0+(compatible;+MSIE+6.0;+Windows+NT+5.1;+SV1;+.NET+CLR+1.1.4322;+.NET+
CLR+2.0.50727) http://www.ostlund.stream.hv.se/soka/idxMejl.html 200 1284 567
2008-03-12 07:49:58 GET /soka/soka2.css - - 212.3.12.1 HTTP/1.0
Mozilla/4.0+(compatible;+MSIE+6.0;+Windows+NT+5.1;+SV1;+.NET+CLR+1.1.4322;+.NET+
CLR+2.0.50727) http://www.ostlund.stream.hv.se/soka/mejlMain.html 404 1819 403
2008-03-12 07:53:13 GET /soka/idxStart.html - - 212.3.12.1 HTTP/1.0
Mozilla/4.0+(compatible;+MSIE+6.0;+Windows+NT+5.1;+SV1;+.NET+CLR+1.1.4322;+.NET+
CLR+2.0.50727) http://www.ostlund.stream.hv.se/soka/navKurs.html 200 586 567
```

Figure 14. Log data excerpts

In the web log the individual hypertext markup language documents (html) are logged and it is possible to determine which specific document was loaded, when and for how long it was loaded in the employee's computer. It was then also possible to see in what order the documents were loaded. Hypertext is often defined as non-sequential writing and reading of information (Nielsen, 1995) although it is still possible to make a strictly linear hypertext document by only linking to the nodes that are next in the intended order. Linear hypertext documents are useful when the information that is being presented by the system is meaningful to the users only when received in a specific order. For some educational and instructional purposes, a step-by-step procedure of this kind is very useful. Although the WLA is intended to be followed in a specific order, a linear structure with options was chosen, meaning it is structured in a certain way, but all modules in the structure are reachable at all times, and the user can choose to see the modules in any order (Powell, 2000). This gives the users the choice to either take the modules in the suggested order (in one try or at two or more occasions), skip certain modules, or take the modules in an exploring, unordered way. The users also have the opportunity to go back and revisit certain modules directly. The path history or clickstream of how the users navigate through the WLA is stored in log files on a server.

To analyze the users' clickstream the process of web usage mining (WUM), often used in the electronic commerce area, was used to extract the navigational behavior patterns. WUM consists of the core phases: data pre-processing, pattern discovery and pattern analysis (Cooley et al., 1997). The data pre-processing phase can be divided into 7 sub-processes: data cleaning, data filtering, user identification, session identification, path completion, data enrichment, and transaction

identification (Marquardt et al., 2004). The task of data cleaning aims at removing irrelevant records like accessing a CSS file or the loading of irrelevant pictures such as logos. For the purpose of this paper entries from files like soka.css and hv_logo_se.jpg were edited out (see figure 15).

Edited log files
2007-03-15 08:49:07 GET /Attsoka/02.html - - XX.XXX.XX.95
2007-03-15 08:58:20 GET /Attsoka/03.html - - XX.XX.XX.95
2007-03-15 09:04:46 GET /Attsoka/04a.html - - XX.XX.XX.95

Figure 15. The log files after irrelevant records were edited out

In the data filtering phase (Marquardt et al., 2004) a subset of data relevant for the mining objective is extracted, e.g. selecting a set of records from a certain activity or period. Since the studies in this paper had clear test periods, the records from the test periods of the WLAs were chosen. When it came to user identification the use of proxies at some of the workplaces in the study could potentially make it difficult to distinguish unique users in some cases. Normally when users have the same IP address unique users can sometimes be identified if they use different operating systems or browsers (Cooley et al., 1999) since this also is registered. At the workplace in this study the employees’ computers were batch installed and therefore had the same operating system and browser. Despite this, multiple sessions can be traced to a unique user with high probability if e.g. pages 01.html through 05.html are accessed and later the same day pages 06.html through 09.html are accessed. Overall the issue of identifying unique users is not essential for this study since it was deemed of little value in this relatively small website that made up the WLA to be able to say that 50 % of all users who accessed the first video module also visited the read more module.

The task of session identification consists of grouping the users' visits into session units (Marquardt et al., 2004). The web server that hosted the WLA had a session timeout set to 30 minutes which means that if a user does not change page or refresh the page they are currently visiting; the server stops logging after 30 minutes as if the user leaves the web site. The WLA consisted of html frames in the sense that the main menu was placed in a separate frame and the different modules like Web lecture were loaded in a frame below the main menu. This way the menu is always present at the top, but it also means the URL does not change when the user clicks on a link within the WLA. The consequence of this is that a user, who is e.g. looking at the video module that lasts approximately 50 minutes, will be logged as two sessions. The solution for this is to look at all sessions that are 30 minutes and see if the next session matches the previous one's identity and pattern wise. This only occurred twice in the logs. Another issue when identifying unique user sessions, addressed in the path completion phase (Marquardt et al., 2004), is to determine whether or not there are any user accesses that are not recorded in the log file, e.g. if a user leaves the site or if the user is backtracking and accessing pages from a cache instead of the web server. The WLA had external links in the read more module and links to Google, Sunet and Yahoo in the streamed video module. Since the users are encouraged to visit Google, Sunet and Yahoo in the different exercises, the WLA logs will be examined where these entries are to see if two sessions in the web log in reality are one session where the user leaves the site to test what they have learned.

In the data enrichment phase (Marquardt et al., 2004) the log entries are enriched with data from e.g. user profiles. Because of the difficulties with user identification mentioned above, the only enrichment of data that was done was that of geographic

data although it was not used in the analysis. The final task of the data pre-processing phase is transaction identification (Marquardt et al., 2004), where sessions are grouped into smaller and more significant page groups.

For the questionnaires, an online survey tool called SurveyMonkey (www.surveymonkey.com) was used. There are both pros and cons with an online questionnaire. The pros are that online questionnaires are time and cost saving ways of collecting data (Dillman, 2000; Sax et al., 2003). The problem of reaching all intended respondents is a potential drawback with online questionnaires, but since all of the employees at the county administration have access to the Internet and a computer, that potential drawback is not an issue in this case. The problem with different browsers displaying the questionnaire in different and maybe even discouraging ways is not a problem either since all the employees at the county administration at least have Internet Explorer 5.1 or Windows 2000 or XP, and the questionnaire was tested on those platforms.

5.8.1 Prize awards

Porter and Whitcomb (2003b) state that the literature on incentives and response rates and their own study show that post-paid incentives in general, and lotteries in particular, have little or no impact on survey response, although some studies indicate that prizes resulted in lower dropout rates (Frick et al., 1999). Another issue is the size of the prize. If the prize is too valuable or too small it will not affect the response rate (Porter and Whitcomb, 2003b). What can lead to a higher response rate other than offering prizes is informing the respondents that the survey contributes to scientific research (Bosnjak et al., 2001) and using resources on a

second or third reminder is more rewarding response rate wise than prize awards (Porter and Whitcomb, 2003b).

The uncertainty of prize awards having an effect and the fact that the participants in this survey are not students, which is the case in most of the other studies, meant that it would be hard to anticipate what an appropriate prize would be. Instead participants were informed beforehand that reminders would be sent out and that the result would be used to improve the quality of future e-training solutions at the County Administration. Moreover, they were informed that the questionnaire was anonymous and that the data would not be released to any third party.

5.8.2 Response bias

According to Sax et al., (2003) response bias refers to how the questions are interpreted and answered, and nonresponse bias refers to bias that comes from non-respondents being different from respondents in terms of demographic or attitudinal variables. In order to include as many respondents as possible and prevent response bias, it is fundamental to ensure that the participants understand the questions and that you ask the questions in a neutral way without leading them on.

A low response rate does not suggest bias if the respondents' characteristics are representative of non-respondents (Sax et al., 2003). Bosnjak et al., (2001) suggest seven response patterns instead of the traditional unit nonresponse, item nonresponse, and complete response. The seven response patterns are: 1) Complete responders, 2) Unit non-responders, 3) Answering drop-outs, 4) Lurkers, 5) Lurking dropouts, 6) Item non-responders and 7) Item non-responding dropouts. Complete responders are as the name indicates responders who answer all the questions and

complete the survey whereas unit non-responders are those who choose not to participate in the survey at all. The reasons for a unit nonresponse could be either that the person is technically hindered from completing the survey or simply chooses not to participate. Answering drop-outs are those who answer all the questions but drop out before submitting the survey. Lurkers are the ones that drop out after viewing all the questions without answering any of them. Lurking drop-outs quit the survey even before they have viewed all the questions. Item non-responders view all the questions, but do not answer all the questions before submitting the questionnaire. Item non-responding dropouts are those who answer some questions but leave some unanswered before quitting the survey.

Putting personal questions in the beginning of the survey can reduce dropouts and may also lead to more complete demographic data (Frick et al., 1999). Eliminating the frustrations that arise with drop-down boxes, open-ended questions and unclear skip links are all things that can reduce non-respondents (Umbach, 2004). The availability of the participants was confirmed with the County Administration before sending out the introduction letter to ensure that the participants were available.

The seven response patterns by Bosnjak et al., (2001) can be used when designing a survey as flawlessly as possible. Avoiding answering drop-outs can be done by making the completion of the survey clear and easy to understand (Bosnjak et al., 2001) and at the end of the survey there was a button that said “done” and a help text that said “click on done to finish the survey”. All the questions were not displayed at once, thereby minimizing the risk that the responders wrongly estimated the time needed to take the survey in order to lower the amount of lurkers (Bosnjak et al., 2001). Keeping respondents from becoming discouraged by

providing them with a progress timer is also important (Umbach, 2004). SurveyMonkey provides feedback on how much of the questionnaire the participants have completed (see figure 16 below), which avoids lurking dropouts and answering dropouts. To avoid item non-responders and item non-responding drop-outs focus was put on making the questions easy to understand. This was further strengthened by having people from the organization test the questionnaire and give feedback on any unclear formulations or choice of words.

The screenshot shows a web browser window with the address bar displaying "http://www.surveymonkey.com - Enkät - Att söka på WWW - Mozilla Firefox". The browser's menu bar includes "File", "Edit", "View", "History", "Bookmarks", "Tools", and "Help". The page title is "Enkät - Att söka på WWW" and there is a link "Avbryt enkäten >>".

Question 20: "20. Vad tyckte du om webbföreläsningens innehåll?"

- ☐ Mycket relevant (80-100% relevant innehåll)
- ☐ I stora delar relevant (60-80% relevant innehåll)
- ☐ Ganska relevant (30-60% relevant innehåll)
- ☐ Mindre relevant (0-30% relevant innehåll)

Kommentera gärna:

Question 21: "21. Hur stämde webbföreläsningen överens med dina förväntningar på den?"

- ☐ Mycket väl
- ☐ Väl
- ☐ Mindre väl
- ☐ Inte alls

Kommentera gärna:

Progress bar: 73%

Navigation buttons: "<< Föregående" and "Nästa >>"

Figure 16. Completion feedback example from SurveyMonkey

5.8.3 Contacting respondents

The respondents were contacted by email that explained what the study was about and invited them to participate by following a hyperlink included in the email. The email was sent from an email account within the organization, namely from one of the founders of the county administration academy. This was deemed to increase the credibility but more importantly, it lowered the risk of the email being classified as spam, both by the recipients and by the mail server. A potential drawback is that any questions the respondents have would be sent to the county administration email and then forwarded to the author resulting in a longer response time. It was signed by both myself and the representative from the county administration academy but was not personalized with e.g. Dear Mr. Adams, since it would take extra time and have a low impact on the response rate (Porter and Whitcomb, 2003a).

5.8.4 Survey mode

When making a survey you can choose to either use one single mode, e.g. web based survey only, or you can choose to combine modes. When combining there is an issue of the order, i.e. should the web survey be distributed first and then the mail survey sent out as a reminder or should the respondent be given the opportunity to choose? Beebe et al., (2007) made a study where they randomly sent out an initial survey via mail and a web survey to the non-respondents or vice versa, i.e. an initial web survey with a mail survey follow-up to non-responders. They found that the response rates were higher when the order of the surveys was mail/web (70,5 percent) than when the order was web/mail (62,9 percent). The cumulative response rate was also higher in the mail/web alternative (from 38 percent to 47 percent) than in the web/mail alternative (from 37 percent to 57 percent), although the author

suggests that some of the difference is due to the fact that a link to the web survey was missing in the e-mailed reminder. Carini et al., (2003) made a similar study on students, but the students were given the option to use a web survey, which 22% did. Carini et al., (2003) found that differences between the groups were generally small, but the students who chose the web survey responded more favorably to the questions.

If the response rate after the reminders had been unacceptably low, one could consider sending out a mail survey to make sure that the non-responders are not responding just because of their attitude against computers or their computational inability to fulfill the survey. Carini et al., (2003) also speculate as to the reason for the more favorable responses to their web survey being because the respondents were more IT oriented, which further emphasizes the importance of a reminder if the response rate was too low.

6 First Cycle - Designing E-training

In this, and the three following chapters, the four cycles of design research that contributed to the formulation of the design principles for e-training are described and discussed. The structure follows that of the chosen approach of Vaishnavi and Kuechler (2008), i.e. Awareness of problem, Suggestion, Development, Evaluation, and Conclusion. Each chapter concludes with a design principle or principles that were crystalized from that specific design research cycle.

As described in chapter four, the county administration of Western Götaland decided on an e-training web lecture aiming at improving the employees' skills in information retrieval and online searching. In particular, the course intended to address web searching using public search engines such as Google and Yahoo. The topic of information retrieval and online searching was considered suitable since it was a low-risk topic that was not crucial to the organizational processes, and thereby no core processes of the county administration would be affected if a learning outcome was not achieved. Additionally, the topic of information retrieval made it possible to test different technological modalities like text, video, and audio.

To not interfere with the employees' daily work, it was important that the web lecture was adapted to the conditions of technology enhanced workplace training, and that the web lecture could be used for other topics and content. Hence, the goal was to develop a design concept for web-based lectures that could be used on other e-training courses. As for the content, the researcher had previous expertise on the topic, most significantly from having conducted numerous lectures on information retrieval and online searching. The content was structured and covered a short introduction about how the Internet works, different search techniques and

strategies, and the need to be critical of sources of information from the Internet. The content of the WLA is described in detail in chapter 7.3. In the first cycle, only parts of the content were created to help visualize the concept at an early workshop.

6.1 Awareness of problem

The problem that initiated the research process was a lack of research that acknowledges the complexity that the interplay between technology and pedagogy creates when designing systems for learning and training in the workplace. A literature review resulted in some design oriented theories and frameworks (e.g. Hung and Chen, 2001, Herrington, et al., 2010, Hardless, 2005). Authentic e-learning by Herrington et al. (2010) was chosen as a first step towards a solution to the previously presented problem. Authentic e-learning consists of the following nine pedagogical principles:

1. Authentic context
2. Authentic tasks
3. Access to expert performances and the modeling of processes
4. Multiple roles and perspectives
5. Collaborative construction of knowledge
6. Reflection
7. Articulation
8. Coaching and scaffolding
9. Authentic assessment

The design frameworks guiding the design of the GUI (e.g. the placement of the different graphical elements in the GUI) were also implemented during this phase of the project. The design principles by Norman (1988), the principles for web

design by Nielsen (2000) and the interaction design recommendations by Rogers et al., (2011) were the foundation for the development of the first prototype. The prototype used the following principles:

1. Visibility
2. Feedback
3. Natural mappings
4. Affordances
5. Flexibility
6. User experiences

Only the digital resources (e.g. the multimedia segments) needed for the pilot system were developed during this cycle. They will be described and discussed in the next cycle.

6.2 Suggestion

Based on the pedagogical design framework of authentic e-learning (Herrington, et al., 2010) and the design frameworks for the interaction design and usability, (Rogers et al., 2011; Nielsen, 2000; Norman, 1988) a pilot system was built and tested in the IT environment at the county administration. Pries-Heje et al., (2008) suggest that an evaluation of an IT artifact can also be done prior to the development phase, if a design specification is produced. The pilot system was that and more. Even if it was not a complete and fully functional system, all the different elements were represented, like navigation elements, streaming video, etc. To bridge a generic design theory with the specific contexts and content where theory is to be applied in actual design practice, Hardless (2005) suggests that design concepts can be instrumental to that effect.

To illustrate these concepts a genre framework for techno-pedagogical design concepts (Svensson & Ostlund, 2007) are used. The framework is organized as a table with three rows – one for each of the primary genre dimensions: form, content and functionality (Shepherd & Watters, 1998). The framework uses the narrative structure, i.e. a series of activities organized sequentially or in parallel as the primary structural element. The narrative, being an observable structural feature, obviously relates to the form of the genre. Each activity in the narrative generates a column in the framework, where information on content and functionality can be added. Figure 17 shows how the narrative structure can be illustrated graphically.

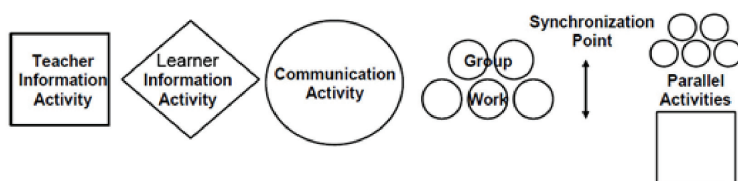


Figure 17. Graphical illustration of the symbols used to describe the narrative structure of techno-pedagogical genres

The symbols used to illustrate the narrative structure also capture additional form elements. Rectangles imply information activities, whereas circles relate to communication activities, and by tilting a rectangle 45 degrees it is possible to differentiate between student-centered and teacher-centered information activities. A specific symbol is also used to mark the position of a synchronization point (Lundin, 2003), i.e. a point in time in the sequence of activities where participants need to be temporally coordinated (typically a deadline). In table 22 the web lecture concept is illustrated graphically using the genre framework for techno-pedagogical design concepts (Svensson & Ostlund, 2007).

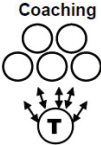
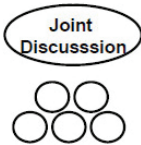
Narrative Structure (Form)	Lecture Material	Video Lecture		
Content (Substance)	Presentation of central concepts and supplements to lecture readings	Modularized information of subject matter Presentation of exercises	Learner-instructor interaction when the learners need coaching & scaffolding	Learner-learner interaction
Functionality (Medium)	Hyperlinks to web resources	Hyperlinked table of content. Student control of video-stream (fast forward, rewind, pause etc.)	Text-based correspondence via e-mail	Text-based interaction in threaded discussion forum

Table 22. The concept of the web lecture application adapted from Svensson & Ostlund (2007)

The concept is based on flexibility meaning that an activity can start at any point in the structure. The web lecture itself is also structured but modularized, so learners can engage in the video lecture at an appropriate level for them.

6.3 Development

In the first cycle, the WLA pilot was developed with a production tool provided by Microsoft that was free of use for all licensed users of PowerPoint called MS Producer. This tool was promising because it had a very lean way of producing a web lecture. Early prototype tests of how the GUI looked and behaved in different

browsers and on different platforms, made it evident that the web lecture developed with MS Producer only ran smoothly on Windows XP (the latest version of Windows at that time) because of its advanced use of HTML layers and style sheets. Since earlier discussions with representatives from the county administration had clarified that some of the employees at the county administration only had Windows NT, it was not an option to use MS Producer for the development phase. In the presentation of MS Producer, it was stated that web lectures produced with MS Producer would run on operating systems including Windows NT, but in reality, this was not the case.

The choice then fell on an XML based synchronization language called SMIL (Thierry, 2009). SMIL stands for Synchronized Multimedia Integration Language and is a markup language for synchronizing different media streams (Thierry, 2009), e.g. showing five pictures for five seconds each, while an audio file is playing and a short movie is shown. SMIL gave a developer great freedom concerning layout and re-usability of the content. To run a SMIL application a standalone application such as the Ambulant Player had to be installed on the computer.

Web usability is the ease and effectiveness with which users can use the features of a website (Nielsen & Loranger, 2006). The following section describes how the GUI principles presented in chapter three were implemented.

All the things you can do in a system must be visible and it must be obvious where in the system the users are (Norman, 1988; Rogers et al., 2011), hence the main navigational scheme of the web lecture application is always available at the top of the screen and the user's position is visualized with colors (see figure 18). In this way, it is clear to the user what part of the lecture will be activated when clicking

on an element in the GUI. Additional navigational schemes are placed to the left. (GUI principle 1 and 3)

The different links are either traditional blue underlined links or they are made to look like buttons, so it will be natural to click on them. Visited links change color to the standardized purple color (GUI principle 4 and 6). All together this answers the three fundamental questions of navigation: where the users are, where they have been and where they can go (Nielsen & Loranger, 2006; Rogers et al., 2011).



Figure 18. The pilot version of the web lecture application

From the main navigation menus the users can access the streamed videos, a discussion board, information on how to contact the teacher (in this case the same person who narrated the web lecture), and a list of links with additional resources on how to search the World Wide Web (WWW). The users can also access the starting page (Home) of the web lecture application where the overall aim and the main navigation menus are explained.

The navigation takes up less than 20% of the screen, which leaves more than 80% for the information, which is preferable (Nielsen, 2000). To enhance readability, the text is black sans serif on a white background. The sentences are not longer than 60 positions, so the users do not lose track of where the next sentence is (Nielsen, 2000) when finishing a sentence. The system is adapted to a resolution of 800x600 which is supported by the computers at the county administration (GUI principle 5).

The user should always get full and continuous feedback on all the choices they make (Norman, 1988; Rogers et al., 2011). When a user clicks on one of the videos, the duration of the video is shown on the status bar at the bottom of the video area. If the video does not start immediately, the status bar gives the users feedback on how much buffering is left before it begins (GUI principle 2).

Making it easy to determine the outcome of actions in advance (Norman, 1988; Rogers et al., 2011) can e.g. be done by informing the users beforehand if any links they click on are opened in another window or not and using logical names on buttons. If the users have any previous experience of interacting with similar systems, it is important to take advantage of them and completing similar tasks should have similar operations and use similar elements throughout the system (Norman, 1988; Rogers et al., 2011). The buttons that are used to manipulate the

video streams (e.g. play, pause) are the default ones from MS Windows Media Player and resemble the buttons users are familiar with from e.g. DVD and CD players (GUI principle 3 and 6).

6.4 Evaluation

The WLA pilot was evaluated through a workshop with two representatives from the county administration. The demonstration made it clear that the WLA had to be re-designed. Since the county administrations must guarantee a functional public service, both in peacetime and in wartime, the installations of SMIL applications from a certified software developer were deemed too great of a risk. The extra workload that is incurred with installing and updating a new application on each employee's workstation was an additional problem. The WLA needed to run on one of the applications already available in the IT infrastructure of the county administration.

6.5 Conclusion

The first cycle resulted in an organizational and infrastructural reality check that resulted in a need for a redesign of the WLA with respect to the platforms it should be able to run on. It was deemed by the County administration at Western Götaland that to achieve a sustainable solution, the web lecture needed to be able to run without any plug-ins or extra software. The data from this design science research cycle generated a new emergent design principle (Åkesson et al., 2010). The knowledge flow from this cycle that feed back to the next cycle was that the designer should consider the organizational and infrastructural reality prior to building the

WLA. In conclusion, the evaluation of the second design research cycle tentatively indicated the following principle:

Principle #I (Emergent):

The limitations and opportunities of the organizational and infrastructural context must be carefully considered as a frame for the design of e-training.

7 Second Cycle - Exploring Usability and Work-Integration

The first design research cycle provided an early wake-up call for the project, in the sense that the organizational constraints surpassed the technological opportunities. The goal was then to build a web lecture system for e-training. The web lecture application (WLA) was based on the conceptual design from the suggestion phase in the first design cycle. The new design would now be adapted to the constraints of organizational infrastructures.

7.1 Awareness of problem

The first design cycle made it clear that the WLA needed to be re-designed. Due to a combination of organizational and technological constraints with respect to the infrastructure at the county administration, it became evident that a design solution needed to comply with the software programs that already existed in the IT infrastructure. The existing organizational setup was not yet adapted for streaming multimedia, and consequently, firewalls were not configured to deal with an optimized configuration of multimedia. In conclusion, the second design research cycle had to base the design of the WLA on the technological common-denominator-baseline of Swedish county administrations at that time.

7.2 Suggestion

On a design-conceptual level, the WLA did not substantially change from design cycle one to cycle two. Instead, the suggestion to the perceived problem had to

acknowledge how the existing design concept could be translated into a format and an architecture that harmonized with existing organizational structures and IT infrastructure. Since all computers, laptops and other online devices at the county administration of Western Götaland was, at that time, equipped with MS Internet Explorer, the choice fell on EXtensible HyperText Markup Language (XHTML). With basic XHTML-pages using frames, it is possible to embed streamed video clips and create a WLA based on hyperlinks. This limited the design possibilities slightly since it is not possible to control the exact placement of different graphical elements in the same way as it is with SMIL when using XHTML.

The streaming multimedia was placed on a stream server at University West. The stream server had been used in distance education programs and courses at the university for years and was a stable solution for the multimedia files that where to be used in the WLA. For the sake of the research project it also meant that the web logs intended for the evaluation were fully and easy available.

7.3 Development


The development phase was two-folded, and first the course content was created. The topic, how to search the WWW, was previously known to the author, who for the case of the thesis, acted as an expert and content provider as well as the developer of the system. In his role as a teacher at a university, the author had held lectures on how to search and evaluate information on the Internet as well as how the Internet works. Still, a literature survey on the topic of searching on the WWW was done to brush up on the latest insights. According to the representatives from the academy of the county administration, Google's search engine was the dominant tool used for searching on the WWW at the county administration. Google was also

the search tool used in the lectures previously held by the author as a teacher. Nevertheless, a run through of Google's different functions was carried out before preparing the power point slides that would serve as a structure and script for the screen recordings. These screen recordings would then be divided into modules and converted to a format for streaming video. Next the WLA with its content and functionality are described.


The home section

In the figure below the employees are informed about the overall purpose and content of the WLA and that the time to finish the web lecture is estimated to approximately one hour. It is stated that the WLA is created in cooperation with the University West and the logos of University West and the county administration of Western Götaland are placed to the left.

Home	Web lecture	Discussion	Contact the teacher	Read more
-------------	-------------	------------	---------------------	-----------



LÄNSSTYRELSEN
VÄSTRA GÖTALANDS LÄN



HÖGSKOLAN VÄST

Welcome to the course

How to search the WWW

This is a short course on how to search the World Wide Web (WWW). It is approximately 50 minute long. The course provides general and specific tips on how to get better and more relevant results when searching for information on the WWW. Above you can see the navigation for the web course. By clicking on "Home" you return to this page. "Web lecture" is the lectures in the form of recorded video clips with some exercises. Under "Discussion" you can discuss and evaluate the course using a blog. Under "Contact the teacher" you will find my email address and under "Read more" there is a collection of links where you can learn more about searching the WWW. The course was developed in collaboration with University West.

Figure 19. The home page i.e. the first page you arrive at when clicking on the link from the county administration academy portal (translated into English)

The web lecture section

The video part of the WLA consists of streamed video at 640 x 480 pixels embedded in XHTML pages (see Figure below). The videos are either narrated slides or narrated screen captures of for example a search for Beatles using the Google category search. The structure of the web lecture is outlined below:

1. Welcome
2. Introduction
3. What is the Internet
4. Searching with Goggle
5. Images, news and categories
6. Exercise 1
7. Search techniques
8. Exercise 2
9. Advanced search
10. Exercise 3
11. Classification by subject
12. Exercise 4
13. Search strategies
14. After the search

In all there are 14 modules. Not counting the first static welcome page and the four exercises, the nine remaining modules ranged from three to eight minutes each. Next the content of each module will be explained in detail.



Figure 20. The start page for the web lecture section (translated into English)

The first module of the web lecture is a static welcome page with picture and text explaining the practical aspects of how to get started with the web lecture and how the web lecture works (Figure 20). The navigational scheme and how to start the individual modules is pointed out along with the functionality of the control panel for the video clips. Using the control panel, the employees can pause the video clip and also skip forward or jump backwards in the content of the individual modules

if desired. Feedback on the length of the respective video clips is given below the control panel. It is also possible to adjust the volume in the control panel.

Next under “Introduction” the expert and the content provider, in this case the author, is presented and the employees are welcomed. The structure of the web lecture consisting of three major parts, is outlined. First there is an introduction to the Internet and then different techniques used to find and fine tune searches on the WWW. The third and last part of the web lecture is different strategies for finding the right information, and how to be critical to the sources on the WWW. It is also mentioned that in between the different search techniques there will be exercises.

In the following module, “What is the Internet” the basics of how the Internet works are illustrated. That meant explicating on the fact that the Internet is a huge amount of computers that are connected to each other, and it is on these computers at different places around the world that the different home pages we surf to are located. Surfing to the different home pages is done by writing their unique web address also called a URL. The concept of the Intranet being a network within organizations where the Internet technique is used is also described along with other services that use the Internet like e-mail.

The module on search techniques “searching with Google” uses Google as an example and starts with a presentation of the different categories to search within: Web, Images, News and Category/Classification. A simple search for the Beatles home page is shown (see figure 21), followed by a demonstration on how to use the minus sign for excluding words and the quotation marks to search for exact phrases. Advanced searches, such as searches within a certain domain, from a certain date and so on are also elaborated upon. It ends with different ways of searching (free

text searching vs. classification systems) and problems of getting relevant search results.



Figure 21. A narrated screen capture exemplifying a search in Google (translated into English).

The Images, News and Category/Classification that were previously discussed are in this module exemplified by using searches for Beatles again. How to find images with different resolution and the importance of resolution on an image vis-a-vis what the image is to be used for are elaborated upon. Hence, it is explained e.g. that

if the image is to be used for print the resolution needs to be high. A search for news, news groups and blogs on the Beatles was also demonstrated in this module.

After these basic ways of searching the first exercise was presented. In that exercise, the employees were encouraged to do a search of their own. If they could not think of anything to search for the home page of the music group Abba and the home page of the county administration were suggested. When they had done their first search they could also narrow it down to only include web pages from the top domain .se or to only include web pages in Swedish and see how that affected the search result. Lastly, they would search for images, news, groups and blogs.

Following the exercise different search techniques to further refine the search results were presented. One way is to add additional search words to the search string e.g. adding Yoko to a search on Beatles will result in web pages about both the Beatles and Yoko Ono. Next the use of the minus sign (-) to exclude web pages from the search result was demonstrated. As an example, a search for Titanic is used where hits about the movie Titanic is excluded by entering the search string: Titanic - movie. After that the use of quotation marks is shown by making a search for the quote: "to be or not to be" in order to find the monologue by Hamlet. The fact that Google is case insensitive and that the wildcard symbol (*) does not make any major difference when searching is mentioned.

The second exercise is about using the previously described search techniques. As guidance a search for Abba -music is suggested as an example of how to exclude hits. A search on how to find a song by the Swedish musician Evert Taube by using quotations mark is also suggested. However, the employees are first of all encouraged to make a search relevant for their work by using the search techniques.

The module on advanced search showed how searching can be refined by e.g. limiting searches to include only web pages from a specific top domain like .se or a particular site like www.wikipedia.org or web pages that are updated within a specified time frame. The search can also be limited to only include web pages using a certain language like Swedish. In advanced search, it is also possible to search for, or exclude, specific file types e.g. Adobe Acrobat PDFs, Microsoft Word and PowerPoint. The need for caution concerning virus when downloading files from the Internet is mentioned and that they should only download files from sites they trust or deem trustworthy. Searching for terms in the whole page is the most common way of searching but in advanced search, it is possible to limit that to only be a search for terms in the page title, web address or in links to the page you are searching for. Following this module is an exercise where the employees are simply encouraged to use the different way of advanced searching touched upon.

Next, the searching in catalogues using classification by subject is demonstrated. For this purpose, yahoo.com and sunet.se (Swedish University Computer Network) are used as tools for searching by subject. First, it is shown how you search in the web catalogue of sunet.se with its different subjects such as: politics, healthcare, culture, education, and media. This is done by clicking your way down through the subject categories, which become more and more specific until different web pages in the chosen sub category are listed. The same is done for the search engine yahoo. One example is how to search for the history of the internet. The first category in that search would be; Computers & Internet with the sub categories of; Internet > History > History of the Internet. After this module the final exercise is presented where the employees are to use a search engine using classification by subject and see what kind of information there is in areas relevant to their work practice.

The module on search strategies starts by discussing alternative sources for information retrieval such as their own intranet, libraries, and so on. Strategies on when to use free text searching (e.g. if you have distinct words or phrases related to the topic you are searching for) or classification systems (e.g. if you are looking to get an overview of a topic) are discussed. Different strategies on how to use the right set of keywords and equivalent terms are also discussed along with the importance of critical consideration of the sources for information found on the WWW. In the concluding module of the web lecture, the employees are informed about what to think about after the search. The importance of being critical to the sources and different ways of finding out who is behind the different web pages by e.g. backtracking the URL to get to the home page of the organization behind the information.

In the discussion section the employees could post questions and answers to other employees', and post about the WLA in general in a threaded debate board. Under the "contact the teacher section" information about the teacher's e-mail was available and a text stating that the participants were welcome to contact the teacher about anything related to the WLA.

The read more section had links to resources on the WWW about searching and was divided into two parts, one with links to Swedish resources and one with links to English resources. The links were:

The Swedish links (The translation in the parenthesis was not in the original collection of links):

- *Vilseledning på Internet* (Cheating on the Internet)

(http://www.psyccdef.se/templates/PublicationItem____279.aspx)

A publication about critical consideration of the sources by Gunnar Sjöstedt, assistant professor in political science and Paula Stenström, Bachelor's in political science.

- *Stora sökguiden* (The big search guide) (<http://stora-sok.bth.se/>)

An interactive course in how to search, value and process information by Blekinge Institute of Technology.

- *Lilla sökguiden* (The little search guide)

(<http://www2.bibliotek.hv.se/sokguiden/>)

The big search guide in a smaller format adapted by University West.

- *Illern* (The polecat) (<http://www.lub.lu.se/illern/>)

An online course by the Netuniversitet at Lund University about how to find different types of information.

The collection of links in English:

- *Search Strategies: Search with Peripheral Vision*

(<http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/Strategies.html>)

A step by step guide on how to find information on the Internet by Berkeley University.

- *Searching the WWW: Tutorials, Techniques, Tips*

(<http://keithstanger.com/search.htm>)

A collection of links with over 30 links to web sites relating to “searching the Internet”.

- *Evaluating Internet Research Sources* (<http://www.virtualsalt.com/evalu8it.htm>)

An article by Robert Harris on how to search and validate information on the Internet.

7.3.1 Authentic e-learning applied to the WLA

In this section the pedagogical design rationale for the WLA based on the framework by Herrington et al., (2010) is described i.e. how each design principle was applied and built into the WLA. The section is structured in the same order as the design principles appear in the original framework.

Pedagogical principle number 1. An authentic context

An authentic e-learning environment should provide an authentic context that reflects the way knowledge will be used in reality (Herrington et al., 2010). For this purpose, Google's search engine is used when exemplifying the different search techniques. Google is the most common search engine within the test organization as well as worldwide. Even if the learners choose to use another search engine the search techniques touched upon in the WLA do not differ radically and the search strategies are certainly the same. The same goes for Yahoo as an example of classification systems, but most likely they will use Google and Yahoo in the same way as in the exercises and at the same computer.

Herrington et al., (2010) encourage designers of learning environments to embrace the complexity of the real life situation and be cautious of oversimplification of real life complexity. The examples used in the WLA were not simplified and search examples were demonstrated in their entirety instead of being broken down into smaller steps.

Pedagogical principle number 2. Authentic tasks

An authentic e-learning environment should also provide an ill-defined authentic activity that encourages students to find and solve problems (Herrington et al., 2010). The examples used when exemplifying the different search techniques are not from their everyday work practice, and they are encouraged to use examples from their work practice in the different assignments. Manipulating the material also enhances learning rather than just passively observing others manipulate the material (Moreno, 2006b), which is why there are four assignments where they use the different search techniques on their own.

Pedagogical principle number 3. Access to expert performances and the modeling of processes

Authentic e-learning environments provide access to expert performances by letting students observe a task before they try themselves (Herrington et al., 2010). Direct guidance from experts also contribute to how employees' learn and gain knowledge (Billet, 1992). In the WLA the author was the expert demonstrating the different search techniques by recording actual searches with screen captures. The author had previously had experience as a teacher giving lectures on the subject of searching as parts of different courses. The author also had a great deal of experience using the different techniques when searching the Internet. This expert guided learning between the learner and the expert is essential for developing conceptual knowledge (Billet, 1992)

Pedagogical principle number 4. Multiple roles and perspectives

An authentic e-learning environment provides the learner with the opportunity to investigate multiple roles and perspectives (Herrington et al., 2010). In the WLA different ways of searching, e.g. free text searching vs. classification systems and

searching the WWW vs. going to the library are discussed. Furthermore, the employees are provided with online resources where they can go in depth and read about the subject from other perspectives.

Pedagogical principle number 5. Collaborative construction of knowledge

An authentic e-learning environment supports the collaborative construction of knowledge (Herrington et al., 2010). The flexible character of workplace training makes it difficult to support and promote real-time collaborative learning since it is very uncertain how many employees will be active simultaneously. Collaborative learning could to some extent be supported and promoted via a threaded debate board, where the employees are asked to post difficult “searches” of interest for their work and how they solved the problem. Then others could be invited to comment or even help if the problem is not fully solved.

Pedagogical principle number 6. Reflection

Students learn better when they are given the opportunity to reflect during the meaning making process (Moreno, 2006b), hence an authentic e-learning environment promotes reflection to enable abstractions to be formed (Herrington et al., 2010). By using examples that are not from their daily practice, e.g. a search for the Beatles, and then encouraging employees in the following exercise to use the techniques with search words that mirror their own work practice, they are helped to reflect on what they have learned and how it can be applied. In this way the e-learning environments focus on real tasks and enable learning through doing and reflection-in-action.

Pedagogical principle number 7. Articulation

An authentic e-learning environment promotes articulation to enable tacit knowledge to be made explicit (Herrington et al., 2010). In e-learning environments debate boards often support this, where groups of students are to reflect on a subject and give substantial comments on other students' comments as a part of the examination (Trevitt, 2002). Again the flexible nature of work-integrated learning makes it hard to create working groups for the employees, but a debate board where they can evaluate and self-assess what they have learned could be a possibility. The employees' were encouraged to post any questions/problems they encountered in relation to the course topic. In this way the employee would articulate what they did not understand or formulate a question about a problem. It could be a problem with a search they had done that did not give the desired result. When other employees' would reply, they would also reflect on what they had learned while formulating an answer.

Pedagogical principle number 8. Coaching and scaffolding

An authentic e-learning environment provides for scaffolding of support and coaching at critical times (Herrington et al., 2010). The employees will be able to email the teacher if there is something that is unclear or if they have questions in general, and they will receive feedback within 24 hours and often sooner. The teacher would also be active in the debate board if any questions or problems should be posted there. Hung and Chen (2001) argue that technology mediated learning environments should have scaffolding structures that utilize the genres and common expressions used by the community. In this study the teacher (the author of this thesis) were not from the County administration, which could pose a potential problem. Being aware of this problem, the teacher would check any uncertainty concerning language and concept used in the learning material with the case

representative at the Swedish academy of county administration. In addition to this, the case representatives would also go through the WLA before the implementation. Scaffolding can also include interactions with an artifact such as an e-training system (Puntambekar and Hubscher, 2005). The clear structure of the web lecture and the opportunity to skip ahead is also a scaffolding structure. It supports the employees' in the zone of proximal development in that they can skip what they can do without the assistance of the WLA and focus on what they need guidance to learn.

Pedagogical principle number 9. Authentic assessment

An authentic e-learning environment should provide for integrated assessment of learning within the tasks (Herrington et al., 2010). The assessment in the searching the WWW WLA will be the employees self-assessing their learning. The outcome of the employees trying e.g. different search techniques is a constant self-assessing process for the employees, whether the use of the search techniques is successful or not. The debate board would also serve as a way of assessing learning outcomes by reviewing and being reviewed by peers.

7.4 Evaluation

The WLA was tested throughout a three-month period (070301-070530) prior to the evaluation. The evaluation relies on three sources of data. Firstly, a questionnaire sent out to 15 employees who completed the e-training course - "Searching the WWW". Secondly, a semi-structured interview with a key informant and course participants was conducted. The questions in the questionnaire and the interviews were operationalized so that the respondents would more easily understand the

questions and so that they would not try to guess what kind of answers I was looking for.

Finally, web log data showing statistical patterns of time-stamped activities from participants' use of the WLA provided an interesting data source for triangulation of subjective statements expressed in interviews or inferred from questionnaire data. Below are the questions from the questionnaire. For the questionnaire in its entirety, see the appendix.

1. Gender
2. Age
3. Are you working full or part time?
4. How much time do you spend at the computer on a daily basis (including time spent both at home and at work)?
5. How often do you search for information using a computer (using the Web, databases, intranet, etc.) compared to searching for information the traditional way (books, files, archives)?
6. How many times in total did you visit this website?
(<http://www.ostlund.stream.hv.se/Attsoka/>)
7. Have you ever gone back to the web lecture and re-watched parts of it?
8. Did you follow any of the links under "Read more"?
9. If you followed any of the links under "Read more", did you find them interesting and was the information valuable?
10. Were you able to carry out your study sessions on time and in a manner that was suitable for you?
11. Did you take any breaks during the web lecture?
12. Did you do any of the exercises?

13. If you completed the exercises, did you do it following the video that preceded the exercise?
14. Did you contact the teacher of the web lecture at any point?
15. Did others participate in the web lecture during the same time as you?
16. How important is it for you to collaborate/discuss the web lecture such as “Searching the Web” with other participants?
17. How much would you like to be able influence the schedule for web lectures?
18. What did you think of the length/duration of the web lecture?
19. What did you think of the length of the individual videos?
20. How relevant was the content of the web lectures?
21. Did the web lecture meet your expectations?
22. Are you satisfied with the web lecture as a whole?
23. Did you take notes while you were watching the web lecture?
24. Did you learn something new?
25. Would you like to take another similar web lecture on a topic of your choice?
26. Have you changed the way you search for information after finishing the web lecture?
27. Do you feel that you have become better at searching the WWW after finishing the web lecture?
28. Would you prefer a text-based version with pictures and the possibility to print the web lecture?
29. Do you have any general comments?

The purpose of the questionnaire(s) was to get a rough outline of the audience of the web lecture design. To what extent was it a homogeneous group with similar backgrounds, experiences, and learning outcomes and to what extent were there critical differences in terms of how they interacted with and perceived the web

lecture. At first glance, the staff of the county administration appears to be a fairly homogeneous group with similar office-based, white-collar work, and they all have academic degrees in their respective field of expertise. However, differences between various user types that could influence design guidelines could still exist.

The questionnaire sample sizes are nowhere near sufficient to draw any statistically valid conclusions from, but for practical reasons the County administration could not provide a larger group of people to participate in the pilot course at this stage of the project. Still the data can provide insights regarding demographics, previous experience and user perceptions that are valuable for formulating design principles.

The online questionnaire had 29 questions with 15 participants (one item non-responder (Bosnjak et al., 2001) who only answered question one through eight). The questions in the questionnaire did not directly question to what extent they thought the guiding principles was implemented but rather addressed this indirectly. The reason for this was two-folded. Firstly, it would be complicated and time consuming to explain the principles and how they were implemented in the WLA. Secondly, even if the principles and how they were implemented were successfully explained, the knowledge of this could make them try and guess what kind of answers I was looking for and thereby bias their answers.

The answers from the questionnaire were then mapped against the guidelines and interpreted. Below is an overview of the questions in the questionnaire mapped against the nine pedagogical principles of authentic e-learning (Herrington et al., 2010).

Pedagogical principle	Questionnaire question
1. An authentic context	20. How relevant was the content of the web lectures? 21. Did the web lecture meet your expectations? 26. Have you changed the way you search for information after finishing the web lecture? 27. Do you feel that you have become better at searching the WWW after finishing the web lecture?
2. Authentic tasks	21. Did the web lecture meet your expectations? 26. Have you changed the way you search for information after finishing the web lecture? 27. Do you feel that you have become better at searching the WWW after finishing the web lecture?
3. Access to expert performances and the modeling of processes	24. Did you learn something new? 26. Have you changed the way you search for information after finishing the web lecture? 27. Do you feel that you have become better at searching the WWW after finishing the web lecture?
4. Multiple roles and perspectives	8. Did you follow any of the links under “Read more”? 9. If you followed any of the links under “Read more”, did you find them interesting and was the information valuable?
5. Collaborative construction of knowledge	15. Did others participate in the web lecture during the same time as you? 16. How important is it for you to collaborate/discuss the web lecture such as “Searching the Web” with other participants?

6. Reflection	<p>12. Did you do any of the exercises?</p> <p>13. If you completed the exercises, did you do it following the video that preceded the exercise?</p> <p>26. Have you changed the way you search for information after finishing the web lecture?</p> <p>27. Do you feel that you have become better at searching the WWW after finishing the web lecture?</p>
7. Articulation	<p>15. Did others participate in the web lecture during the same time as you?</p> <p>16. How important is it for you to collaborate/discuss the web lecture such as "Searching the Web" with other participants?</p>
8. Coaching and scaffolding	<p>14. Did you contact the teacher of the web lecture at any point?</p> <p>10. Were you able to carry out your study sessions on time and in a manner that was suitable for you?</p> <p>19. What did you think of the length of the individual videos?</p> <p>6. How many times in total did you visit this website? (http://www.ostlund.stream.hv.se/Attsocka/)</p> <p>7. Have you ever gone back to the web lecture and re-watched parts of it?</p>
9. Authentic assessment	<p>21. Did the web lecture meet your expectations?</p> <p>24. Did you learn something new?</p> <p>26. Have you changed the way you search for information after finishing the web lecture?</p>

	27. Do you feel that you have become better at searching the WWW after finishing the web lecture?
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Table 23. Questions in the questionnaire mapped against the nine pedagogical principles of authentic e-learning (Herrington et al., 2010).

The questionnaire started with demographical questions. Concerning the first questions about the demographics of the respondents, the distribution between genders was almost fifty/fifty. All age spans were represented with approximately one half, younger than 45 years and the other half, older than 46 years. The majority of the respondents used the computer six hours or more on a daily basis, which indicates that the respondents had high computer skills. A clear majority of the respondents used the computer to search for information rather than using a non-electronic and more traditional way of searching for information.

The question about how many times they visited the WLA addressed the overall research question for the thesis, to see if the technology supported the conditions of workplace training, i.e. was it flexible so that the employees could partake of the content of the WLA at times that was suitable for them? The number of times the respondents visited the WLA to complete the web lecture varied from one time to five times or more. The majority did split the web lecture into two visits or more, but they all finished the lecture during one day. One third split it into two visits, approximately one fourth did it in three or four times and some came back to the web lecture five times or more.

When asked, “How did you take part of the web lecture”, the majority answered that they took the lecture in one go without any breaks and 35% with one or two breaks.

This could indicate that some of the respondents finished the videos and exercises in the web lecture section in one go, but went back to the WLA later to re-watch parts of the lecture or look at the links to other resources. After completing the web lecture, six of the fifteen respondents returned to the web lecture and watched parts of it again, four once or twice and two returned to the WLA three times or more. This indicates that the WLA did support the conditions of e-training by giving the employees the possibility to return to the WLA when their everyday work permitted it.

The question about if they clicked on the links in the Read more section was mapping against the pedagogical principle number 4; Multiple roles and perspectives. This question was designed to evaluate if the employees utilized the other resources on the WLA and if the other resources were meaningful. Two thirds clicked on the links to other sites on how to search the WWW. Resources were put in the WLA to give the employees alternate viewpoints or angles on how to search the WWW. None of the respondents thought the other links were very interesting, which was the highest alternative of the multiple choices. The links were perceived as just fairly interesting or the employees just browsed the web pages. The reason the employees did not use the other resources under read more could be that the topic of searching on the WWW is not so complex that the employees felt the need to partake of other sources to understand.

The questions on whether they completed the exercises and if they did them in connection to watching the lecture part leading up to the exercise was mapped towards pedagogical principle number 6, Reflection. All but two did at least some of the exercises (Figure 22). Most of the respondents who did the exercises did them

straight after the video clip preceding them. The fact that the majority of the respondents did all or most of the exercises points to reflection at some level since the exercises were designed so that they would have to reflect upon what they just learned and apply it to the task in the exercise.

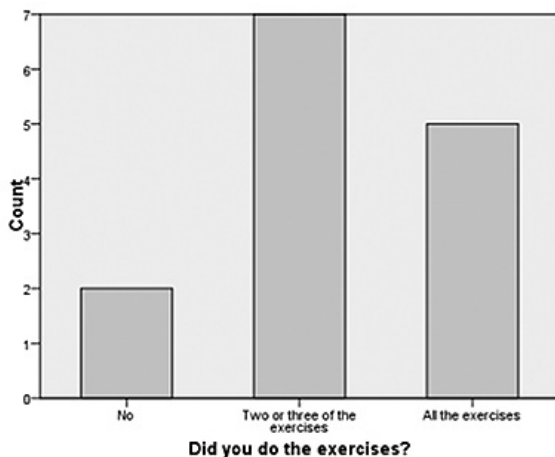


Figure 22. Did the employees' do the exercises.

Pedagogical principle number 8, Coaching and scaffolding was addressed when asking about contacting the teacher. None of the respondents contacted the teacher via the e-mail address on the WLA. In the authentic e-learning framework by Herrington et al., (2010) scaffolding only concerns help from the teacher at critical times or help from other students. That model leans on the apprentice model by Brown et al., (1989), where the apprentice is coached and scaffolding decreases as the apprentice to a higher degree thinks like an expert for him or herself.

While this is an important factor, scaffolding can also be procedural and aimed at assisting the employees in how to use the WLA as a resource. The WLA structure is scaffolding in the sense that the GUI followed established design principles and conventions. Also how to navigate e.g. the video streams are explained in the system and is another way of supporting the users in a system. This in combination with the fact that the topic of searching on the WWW is not a complex topic, could explain why no one utilized the possibility to contact the teacher. To address the pedagogical principle number 8 coaching and scaffolding, the WLA was designed to offer flexibility concerning time and place. When asked about this flexibility a slight majority chose total flexibility, but the spread between scheduled lectures and flexible lectures was quite even.

The majority did not think it was important to collaborate with others who also did the web lecture. This question evaluated the pedagogical principle number 5, collaborative construction of knowledge and the pedagogical principle number 7, Articulation to see if and to what degree the employees would spontaneously engage themselves in discussions with peers and thereby articulate what they had learned and collectively share and create new knowledge. This could also be an explanation as to why the discussion board was unused.

The last section of the questionnaire inquired into the authenticity of the content and their satisfaction with the WLA. When asked about the length the majority thought that the web lecture was just the right length, although one third thought it was a bit too long. None of the respondents felt that the length of the videos in the different modules were too short although one third of the respondents felt they were a bit too long.

All but one felt that the content of the course was at least fairly relevant and the majority felt it mostly relevant indicating that the pedagogical principle authentic context was successfully implemented. The majority thought that the web lecture at least lived up to their expectation and three perceived it as worse than expected. Twelve of the respondents were at least satisfied with the web lecture as a whole. These questions addressed the pedagogical principles 1 and 2, as to whether or not the content and exercises were authentic and thereby relevant. None was totally dissatisfied but 20% was fairly dissatisfied (Figure 23).

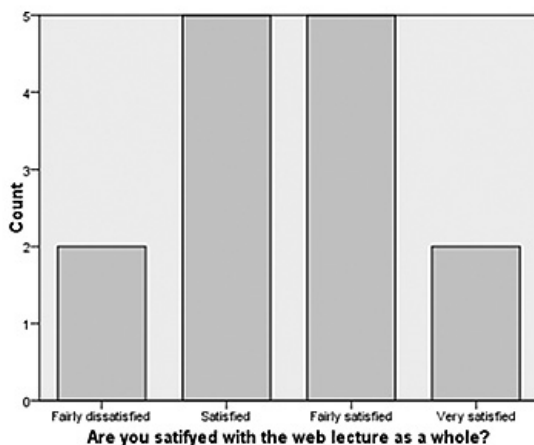


Figure 23. Satisfaction with the web lecture

The questions on whether the employees learned something new and if they had changed their way of searching and had become better at searching addressed the pedagogical principles 3, 6, and 9 namely, Access to expert performances and the modeling of processes, Reflection and Authentic assessment. When the expert is performing the different searches while describing what he did, then the employees'

would implicitly get access to the experts modeling of processes. In order to apply what they learned and thereby change their behavior, there was a need to reflect on how the new knowledge applied to the situation they want to apply the new knowledge in. If the employees then can access whether or not they have become better at searching the WWW after finishing the web lecture, then they have self-accessed the knowledge outcome.

All of the respondents felt that they had learned something new ranging from “learned a lot” to “learned fairly little”. Whether or not they had learned something new addressed the pedagogical principle number 6, reflection. Eleven of the respondents felt that they became better at searching after finishing the web lecture and all but one changed the way he/she searched the WWW after finishing the web lecture. To investigate if the employees had applied their new knowledge to their own context, they were asked if they have changed the way they did searches on the WWW after completing the web lecture. This question addressed the pedagogical principle number 6, reflection, since they needed to reflect upon what they had learned in order to be able to use it in another situation. The question also indirectly addressed the pedagogical principles number 1 and 2, authentic context and authentic tasks, since the relevance of the content and the tasks help the employees to relate and understand how to translate the new knowledge to a new situation. All but one changed the way they did searches after the lecture. 60% had changed it to some or a large extent and 26% to a little extent.

7.4.1 Exploring patterns in use-data

The questionnaire data from the second design research cycle roughly evaluates three interrelated dimensions (that were self-reported by the responders), and they

can be explored for interdependencies and correlation (Use and interaction, Attitudes, and Learning Outcome). These dimensions and the way they are operationalized in the questionnaire are outlined below.

(i) Use and Interaction

a) How did the responder interact with the WLA over time? Did he/she undertake the entire e-training activity in one continuous session (condensed use), or did he/she fragment the e-training into several sessions over a period of time (interruptive use).

b) To what degree did he/she choose to interact with the various resources offered in the WLA? In order to roughly assess this, an exploration score was calculated based on the extent to which the responder: revisited lecture video-clips, explored links to additional material, and completed exercises presented in connection to lecture video clips. The higher the value of the exploration score, the more the responder engaged in said activities.

(ii) Attitudes

How did the responder experience the e-training activity? This was assessed on the basis of the answer to the question: “Please rate your satisfaction with the online training. (five point Lickert-scale, from very dissatisfied to very satisfied)

(iii) Outcome

Perhaps the most difficult aspect to assess through a questionnaire with self-reported answers from responders is the actual effect of an e-training initiative. For the purpose of this evaluation, the outcome was measured through a single element in the questionnaire, namely: “Did you learn something new?” Of course this is a blunt measure of an important aspect of e-training, but it was deemed to be a good enough

operationalization of a complex issue. Still, it is more of a relative than an absolute measure of effect, and it does not capture whether the organization benefits from the training or not.

7.4.2 Web logs

The web log data was collected during the ten weeks. During that period the 15 participants had visited the WLA 74 times (General Statistics - Total Visits) and stayed there for a total of 12 hours and 37 minutes (Total Visitor Stay Length). The average stay per day during the entire period was 10 minutes and 14 seconds (Average Visitor Stay Length), but the participants did not visit the WLA every day. The average stay per active day (24 days in total) amounts to 31,5 minutes.

Using log data and the employees' clickstreams of how they navigate through the WLA was done to evaluate how well some of the pedagogical principles were implemented. Pedagogical principle number 4. Multiple roles and perspectives, to see how many and how often they visited the other resources page in the WLA. Also pedagogical principle number 6. Reflection, to see if the employees followed the intended structure of the web lecture or just watched selected parts of the web lecture. The log data indicates real use whereas the interviews and questionnaire paints a picture of the employees' perceived use. In the analysis it is then possible to map real use against perceived use and see if the two tell the same story.

Analyzing the employees' clickstreams is the last step in the process of web usage mining (WUM), where the core phases are: data pre-processing, pattern discovery and pattern analysis (Cooley et al., 1997). The data pre-processing phase and its 7 sub-processes: data cleaning, data filtering, user identification, session

identification, path completion, data enrichment, and transaction identification (Marquardt et al., 2004) were the same for both the second and the third cycle and are described in greater detail in chapter 5.8 “Data collection methods”. After grouping the session from the log data as the final step in the data pre-processing phase i.e. transaction identification (Marquardt et al., 2004) seven groups or interaction patterns emerged:

Interaction patterns	
Peeking (P)	Just visiting the home page of the WLA or just the start page for the video module and nothing more
One go (OG)	Going through all the modules in the course in one go
Partial order (PO)	Going through 2 or more video modules of the WLA, but in the intended order
Partial unordered (PU)	Going through 2 or more video modules of the WLA, but not in the intended order, e.g. module 4 then module 7 and then module 3.
Single module (SM)	Just visiting one of the video modules
Mixed modules (MM)	Mixing e.g. streamed video modules with other modules like e.g. read more.
Non video modules (NV)	Browsing the non-video modules e.g. read more and discussion.

Table 24. Interaction patterns derived from the web logs

In the pilot study the frequency of the patterns were distributed as shown in figure 24. The largest group is peeking (P) with 36% suggesting that the employees’ often just visited the home page of the WLA and then left. After peeking (P) two of the most common use patterns was to watch some of the video modules in the intended order (PO) or just visit one of the video modules (SM).

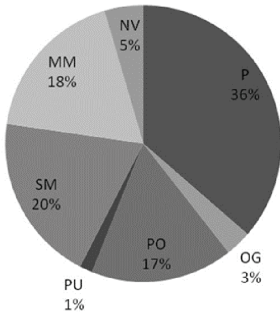


Figure 24. Chart with all interaction patterns from the Exploring Usability and Work-Integration phase (Ostlund, 2012)

Below (figure 25) is a chart of the video module only. In this chart the 18% from the mixed module category is spread out on the partial order, partial unordered single module and one go categories. For example, out of all the mixed module user patterns, 5 of them were visits in the partial order category with additional visits on one or more of the non-video pages. These 5 visits are incorporated into the partial order category.

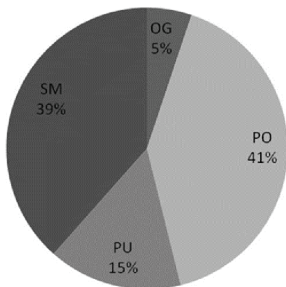


Figure 25. Chart with video interaction patterns from the Exploring Usability and Work-Integration phase (Ostlund, 2012)

The activity statistics show that the most active day of the week was Thursday, although the activity was quite evenly spread throughout the workdays of the week with no activity during the weekends (Figure 26). On average over a day the activity was higher in the mid-morning than in the afternoon and peaked before and after lunch (Figure 27).

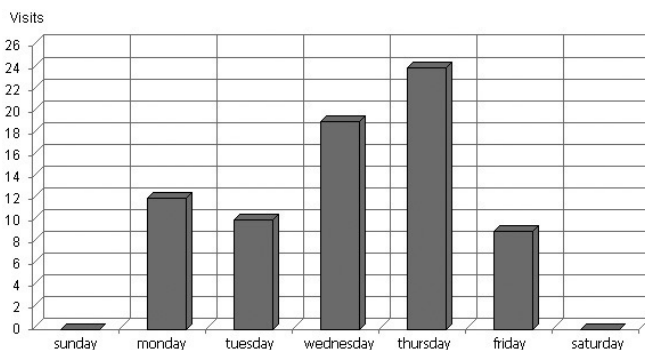


Figure 26. Visits by day of the week

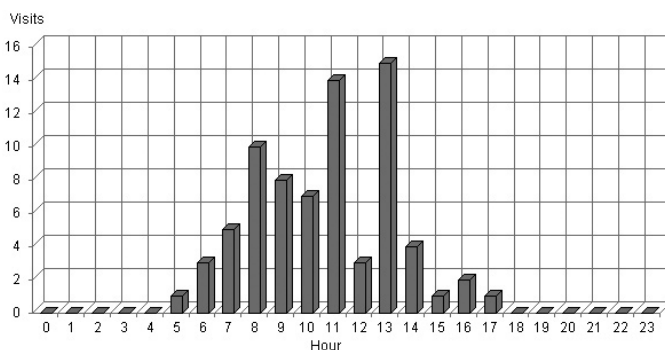


Figure 27. Visits By Hour Of Day

7.5 Conclusion

Looking at how use, attitudes and outcome were distributed and how they were interrelated, some tentative patterns emerged. Firstly, it is interesting to notice that two thirds of the learners reported that they took breaks (interruptive use) and one third did not (condensed use). This is further validated through the log-data, where peeking and partial use (ordered and unordered) are evidence of interruptive use, and the “One-Go” interaction pattern typifies the condensed use.

Looking at how use corresponds to responders’ attitudes and perceived outcomes of the e-training initiative there are no clear patterns to be found. The use-patterns do not seem to influence to what extent the learner is satisfied with the WLA, nor does it affect whether he/she learned something new or not. Still, the data shows that there is a strong positive correlation between interruptive use, the exploration score, and the perception that something new was learned. An interpretation of this is that the realities and the conditions of everyday work forces learners to an interruptive use-pattern, and this in turn creates use/interaction that is more explorative, which in turn results in a perception of higher learning outcomes, but the validity of that claim needs to be investigated further.

In conclusion, the evaluation of the second design research cycle tentatively points to the following two principles where principle #III is adapted from the multiple roles and perspectives design principle (Herrington et. al. 2010):

Principle #II (Emergent):

Design to support for interruptive use, so that learners are supported in prompt repetition of previous use-sessions.

Principle #III (Adapted):

Design for explorative use so learners can create flexible and individual use-patterns.

8 Third cycle - Exploring Incentives and motivation for Collaborative learning

The previous design research cycle indicated that there was a connection between interruptive use of the WLA, exploration of the WLA resources, and the perceived learning outcome. Furthermore, the design principles of collaborative construction of knowledge and articulation had not been validated. In order to further explore these issues, the third cycle supplemented with more interviews of the participants and initiated with addressing the design principles that had not been properly validated.

8.1 Awareness of problem

Collaboration promotes reflection and critical thinking and in order to obtain these concepts a debate board was incorporated in the web lecture application where the users could asynchronously discuss difficult searches they had and how they solved them. If a search problem was unsolved others could suggest a solution. In this way they could reflect on their own learning while giving or receiving feedback when reading others' discussions. Since these lessons learned would be closely connected to their work practice, they would also be interesting from an organizational learning point of view.

Despite this, the debate board was unused and they expressed in the questionnaire that they did not feel collaboration was an important aspect. Although the users all expressed that they had learned something new and their changed ways of searching indicated reflection at some level, it is argued here that the learning outcome would

be of more relevance if they were encouraged to reflect even more. In an attempt to address the shortcomings of the unused debate board a certificate (Figure 28) would be rewarded to anyone who successfully completed an assessment assignment. This would also further validate the design principle of authentic assessment beyond the self-assessment investigated by the questions concerning if they had learnt something new and changed their way of searching.

Länsstyrelse  Akademien

Course Certificate

Name

has finished the course

How to search the Internet

Course content:

- An introduction to how the Internet works
- Simple search
- Advanced search
- Search techniques
- Search strategies

County administration in NN county
20NN

NN
Course leader

Figure 28. The course certificate (translated into English)

Assessment is not the only way of measuring the learning outcome, but assessment is probably what affects how students learn the most (Ramsden, 1992). If reflection

is deemed to be of importance for the learning process, the assessment should consequently focus on reflection. It is also important that the assignment provide the right level of challenge (Herrington et al., 2010). If the assignment is at such a high level that the learners do not expect they will successfully finish it, the learners will not be motivated to engage in the assignment. If the assignment on the other hand is too easy, the learners will not think that the assignment has any value and will not be worth their while.

8.2 Suggestion

With this in mind the redesign of the WLA in the new version incorporated an assessment in the form of an assignment based on peer-review and expert feedback. (see Figure 29).



Figure 29. The assessment process

The assessment has two parts, one part where the employees receive feedback from their peers and one part where they receive feedback from an expert. For the assessment the employees describe a search they have done relating to their work

practice on which they get expert feedback. They also comment on a search description handed in by another peer to actively reflect upon and apply the knowledge they have gained. This addresses the potential lack of articulation, collaboration, assessment and reflection, which are central for authentic e-learning (Herrington et al., 2010).

8.3 Development

The assessment module was incorporated into the web lecture application under a section named “certificate” that replaced the “contact the teacher” section. Information on how to contact the teacher was moved to the “home section”. In “certificate” the assignment was described, and it was estimated that it would take 15 to 30 minutes to complete. For the testing of the new version an invitation was sent out to all employees at the county administration at Western Götaland. 23 choose to take part in the web lecture. Below is a translation of the invitation:

The art of searching the Internet

Do you get too many hits when you search for information on the Internet or do you not dare use the Internet to search for information? Do you not know how to use Google or do you just want to become better at Googling? Then you might want to try a new training for this!

Christian Östlund at University West has created a course that takes about 1 hour on how to use Google to more effectively search for information on the Internet. Through the County Administration Academy, a number of employees at the County Administration get the opportunity to try this new interactive training. The training is done through your computer at work and you can do it in stages at the pace you want. Your obligation as a participant is that you answer a questionnaire (takes about 10-15 minutes to complete) upon completion of the course. Christian will also contact some of you for additional questions. Interested? Click on this link and register for the course on the County Administration Academy's website.

Figure 30. The invitation letter that was sent out to employees

8.4 Evaluation

The 2nd version was tested during a four month period and then another six months after a summer break. The web lecture application was evaluated through an online questionnaire with 11 respondents, 9 interviews and web log data.

8.4.1 Interviews

Out of a total of twenty participants, nine were interviewed. The semi-structured interviews were done over the phone since the interviewees were spread across the western part of Sweden. The interviews were recorded with their permission and stored electronically as mp3 files. They were later transcribed with the help of the transcription software Express Scribe for playback and stored in Word. Later they were coded using ATLAS.ti.

When some of the participants were contacted for the interview they had not started the WLA yet. However, since they expressed their strong intention to participate, they asked to be included in the evaluation, resulting in a rescheduling of the interviews. When contacted later, they had all finished the web lecture. The themes of the interviews evolved around the employees' previous experiences with the WLA and what affected that experience, e.g. how did the work tasks affect the interaction with the WLA? They were based on a semi-structured interview guide with the following sub categories:

1. Work context
2. Computer experience and previous interaction with e-training systems

3. Interaction with system, how they took part of the web lecture.
4. Interaction with peers
5. E- training vs. face-to-face learning
6. Reason for taking the web lecture.
7. The assignment

This was also the point of departure for the coding scheme in ATLAS.ti. For a summary of the interview codes, see the below table.

Summary of the interview codes used in ATLAS.ti		
	Code	Occurrences
1. Work context	Stationed in front of computer	7
	Not stationed in front of computer	2
2. Computer experience and previous interaction with e-training systems	Have attended face-to-face courses	7
	Haven't tried e-training before	6
3. Interaction with system	Considers going back to the WLA in future	6
	Controlled when they took part of the WLA	3
	Did not feel the need for a schedule	1
	Interrupted by work	4
	Split the web lecture 2 or more times	6
	Work tasks controlled when they did the WLA	3

4. Interaction with peers	Did not feel need to interact with others participating in the WLA	7
	Discussed/spread knowledge with peers	3
	Discussed/spread knowledge with people outside work	2
	Discussed with a colleague who also took the WLA	1
	Rather interact with peers	1
	Would like to interact with other participants from the WLA if there was opportunity for it	1
	Would rather ask a colleague than send the teacher an e-mail	1
5. E-training vs. face-to-face learning	Advantage face-to-face -> Ask questions	2
	In-house courses have a schedule which makes you create room for them in your calendar	3
6. Reason for taking the web lecture	Wanted to be better at searching in their line of work	2
	Wanted to be better at searching outside work	1
	Took the WLA out of curiosity	2
7. The assignment	Considers doing the assignment later	2
	Did not have time to do the assignment	3
	No need for certificate	4
	Assignment seemed cumbersome	3

Table 25. ATLAS.ti codes

Most of the interviewees were administrators handling different errands, invoices, or reviewing applications and reports.

“What I’m working with is contaminated areas so I supervise contaminated areas and I work with cases. So my job is about reviewing reports and responding to them”

Seven had attended face-to-face on-the-job-training courses before and for six of the interviewees, this was their first e- training experience. It is also clear that authenticity in terms of workplace training relates to aspects of organizational culture and ethics, something that is illustrated in the following quote:

“To work here has to do with complying with our ways of doing things, it is all about being a professional that knows what he is about, and what he needs to be good at”

Authenticity is also stressed by the interviewees’ when they stressed that the significance of the content of the course need to be relevant to their everyday work. One of the interviewee’s illustrates the importance of “How to search the WWW” to his/her work practice below:

“In my job it is crucial to find accurate information fast. Sometimes I feel like I’m somewhat of an online detective, and the computer is my tool”

The employees also pointed out the importance of easily being able to continue the web lecture after a break or an interruption. Another aspect that came out of the interview process was the fact that some needed a push to get started. When some of the employees were contacted for the interview they said that they had not had time to do the web lecture yet, although they would very much like to. They asked if they could be contacted in a couple of months and when contacted later, they had all finished the web lecture. One interviewee expressed a need for some type of structure:

“One advantage with the local courses we’ve had before, for the most parts it is someone who comes to us and visits the different offices, then there is a time and a place set aside for the occasion. Then you book it and it gets done. These types [e-training like “searching the WWW”. Authors note] when it is up to yourself, you need to be disciplined to get it done. Often it is like: Oh, I don’t have time for this now, it will have to wait. It just never gets done.”

The lack of time was also a factor in their interaction with the system. When asked if they did the exercises one responded:

"Yes, some of them but not all of them.

So you didn't feel the need to...

No, some were quite obvious and some I didn't do due to lack of time really."

Another response to the same question:

"Yes, I did some but at the end I wasn't as ambitious because... well it was a bit more extensive."

The debate board was still unused and when asked about collaboration with other learners they still felt no need for that although some of the interviewees had discussed the content with colleagues or members of their family. They expressed that it made more sense to discuss with their colleagues, even if they did not participate in the web lecture:

"Because it is more spontaneous at the coffee break and yes, sometimes when I visited someone. I've even made suggestions during meetings."

In one case two colleagues in the same department participated in the course, and in that case it made even more sense to discuss it face-to-face.

When asked about e-training in comparison with face-to-face learning, one interviewee responded:

"The advantage with e-learning systems is that you do not need to be at a certain place, I can take part of the education wherever I want. I could even be at home. That's the big advantage, plus that you can do it at a pace that suits you compared to ordinary education. On the other hand you can't make those spontaneous comments. Create a discussion from a problem that appears during the lecture. I miss that to some degree. Another advantage is that you do not have to take notes like a madman, since you always can return to the lecture."

This also further strengthens the pattern of interruptive use from research cycle 2. It could be thought to be the result of different personal preferences of the learners, which is indicated by the following quote from an interviewee:

"A great thing about e-learning is that you could set your own pace, you're not depending on others"

However, even if that cannot be ruled out, several of the other interviews point in another direction. Numerous interviewees stress that it was the realities of everyday

work that made them engage with the WLA over a period of time. As expressed by two of the participants:

“When I was doing the course, something always came up,... or the phone rang.”

“Given my work situation, I can find short time-slots for studying, ... 30 minutes here and 20 minutes there,.. .that means I have to repeat stuff that I forgot from last time”

There is also evidence that interruptive use is caused by the fact that the e-training was rich and dense with respect to what could be learned. One responder stated that:

“There are a lot of search-tips that you need to digest! It is not easy to get it all at the same time”

During the test period none of the 20 participants chose to do the assignment in order to get the certificate. When asked if they considered doing the assignment, one answer was:

“Yes, I would probably consider doing it, I just want to know that I have gone through all the material and know some more. So I don't do it half-hearted. I want to train some more on the searches.”

For others lack of time seemed to be the issue when opting out of doing the assignment, e.g:

“I reckoned that I didn’t have the time. Because it was quite long, it was almost an hour [the web lecture, the authors note], and I felt I didn’t really have the time for the assignment. ”

Lack of time and no real need for or interest in a certificate seemed to be the most common reason not to do the assignment. The assignment also seemed to deter some of the participants.

8.4.2 Questionnaire

The second questionnaire had 11 respondents with two item non-responders (Bosnjak et al., 2001). The first item non-responder only answered the three first questions and the second only the first seven and was therefore excluded from the questionnaire. As with the first questionnaire, the two major concepts of the questionnaire were user behavior and user satisfaction. For the second questionnaire, some changes and additions were made. The changes are listed below:

Question 4, How many hours a day do you use a computer? This was divided into hours at work and hours outside of work.

Question 11, How did you take part in the web lecture? This was divided into eight subgroups instead of just With breaks and Uninterruptedly without any breaks. The subgroups were:

- Uninterrupted without any breaks
- With one or two breaks during one day
- With three or four breaks during one day
- With five breaks or more during one day
- With one or two breaks during two or three days
- With one or two breaks during two or three days
- With three or four breaks during two or three days
- With five breaks or more during two or three days
- With several breaks during four or more days

Question 21, Did the web lecture live up to your expectations? The answer choices were changed from e.g. Very much so to Better than expected since one of the respondents in the first questionnaire answered that the web lecture did not concur with her expectations, but commented that she was pleasantly surprised. Since the answer that the web lecture did not concur with her expectations was perceived as a negative answer the answer choices were changed, see below, to make it clearer if an alternative is perceived as negative or not.

- Better than expected
- As expected
- Worse than expected
- I had expected something completely different

For the second questionnaire two new questions were added:

28. Have you told anyone else how they can improve their searches based on what you have learned in the web lecture?
29. Did you choose to do the assignment in order to get the certificate?

Below is the questionnaire mapped against the nine pedagogical principles of authentic e-learning (Herrington et al., 2010) after the revision.

Pedagogical principle	Questionnaire question
1. An authentic context	<p>20. How relevant was the content of the web lectures?</p> <p>21. Did the web lecture meet your expectations?</p> <p>26. Have you changed the way you search for information after finishing the web lecture?</p> <p>27. Do you feel that you have become better at searching the WWW after finishing the web lecture?</p>
2. Authentic tasks	<p>21. Did the web lecture meet your expectations?</p> <p>26. Have you changed the way you search for information after finishing the web lecture?</p> <p>27. Do you feel that you have become better at searching the WWW after finishing the web lecture?</p>
3. Access to expert performances and the modeling of processes	<p>24. Did you learn something new?</p> <p>26. Have you changed the way you search for information after finishing the web lecture?</p> <p>27. Do you feel that you have become better at searching the WWW after finishing the web lecture?</p>
4. Multiple roles and perspectives	<p>8. Did you follow any of the links under “Read more”?</p> <p>9. If you followed any of the links under “Read more”, did you find them interesting and was the information valuable?</p>

5. Collaborative construction of knowledge	<p>15. Did others participate in the web lecture during the same time as you?</p> <p>16. How important is it for you to collaborate/discuss the web lecture such as “Searching the Web” with other participants?</p>
6. Reflection	<p>12. Did you do any of the exercises?</p> <p>13. If you completed the exercises, did you do it following the video that preceded the exercise?</p> <p>26. Have you changed the way you search for information after finishing the web lecture?</p> <p>27. Do you feel that you have become better at searching the WWW after finishing the web lecture?</p>
7. Articulation	<p>15. Did others participate in the web lecture during the same time as you?</p> <p>16. How important is it for you to collaborate/discuss the web lecture such as “Searching the Web” with other participants?</p>
8. Coaching and scaffolding	<p>14. Did you contact the teacher of the web lecture at any point?</p> <p>10. Were you able to carry out your study sessions on time and in a manner that was suitable for you?</p> <p>19. What did you think of the length of the individual videos?</p> <p>6. How many times in total did you visit this website? (http://www.ostlund.stream.hv.se/Attsoka/)</p> <p>7. Have you ever gone back to the web lecture and re-watched parts of it?</p>

9. Authentic assessment	21. Did the web lecture meet your expectations? 24. Did you learn something new? 26. Have you changed the way you search for information after finishing the web lecture? 27. Do you feel that you have become better at searching the WWW after finishing the web lecture?
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Table 26. Questions in the second questionnaire mapped against the nine pedagogical principles of authentic e-learning (Herrington et al., 2010).

8.4.3 Questionnaire results

In the second questionnaire the majority were female. All age spans (26-35; 46-55; 56-65) were represented except 35-45 with a majority in the 45-55 age span. When it came to previous experience of using Google and using computers in general, all the respondents had used Google previously and the majority a couple of times a week or more. The majority of the respondents used the computer 6 hours or more on a daily basis and all used the computer 3 hours or more. This implies that the respondents had high computer skills. A majority of the respondents used the computer to search for information rather than using non-electronic means, and this was not surprising considering that searching for information with your computer was the topic of the WLA. Looking at interaction with the WLA the majority visited the web lecture once or twice, and six of the nine respondents returned to the web lecture and re-watched parts of it again.

Only one third clicked on the links to other sites providing alternate viewpoints or angles on how to search the WWW. None of the respondents thought the other links were very interesting, just fairly interesting or they just browsed the web pages. The majority felt they could control when they took part in the web lecture. Seven of the

respondents did the web lecture during one workday and seven out of the nine took breaks during the time they did the web lecture, so the majority was showing interruptive use even if they did the web lecture during one day.

All the respondents did some of the exercises and a majority did all of the exercises. All of the respondents did the exercises when it was suggested by the web lecture structure. None of the respondents felt the need to contact the teacher in the second version of the WLA either. Two thirds did not think it was important to collaborate with others who also did the web lecture. One third answered that they thought it important to collaborate with others, but the discussion forum remained unused in the second version of the WLA as well. One third discussed the content with colleagues that did not participate in the web lecture and almost 50% shared with others what they learned by telling others how they can improve their searches. With a slight majority for total flexibility the spread between scheduled lectures and flexible lectures was even.

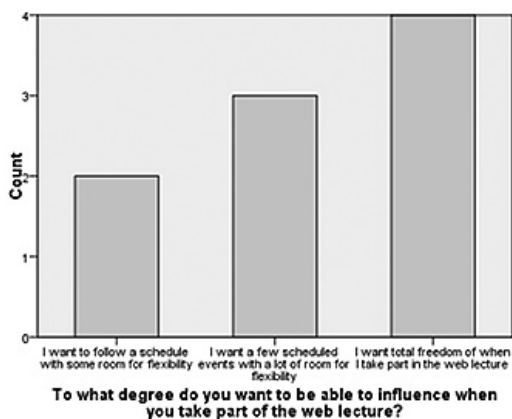


Figure 31. Flexibility vs schedule

None of the participants chose to do the assignment that was incorporated with the WLA in the second round. The reasons for not doing the assignment varied although the majority did not feel the need for a certificate or deemed the assignment too time consuming.

The majority thought that the web lecture was just the right length and two thought it was a bit too long. None of the respondents felt that the length of the videos in the different modules were too short although two felt they were a bit too long. All felt that the content of the course was mostly relevant or very relevant. All respondents thought that the web lecture at least lived up to their expectation and all felt they had learned something new ranging from some to fairly much. Eight of the respondents were satisfied with the web lecture as a whole.

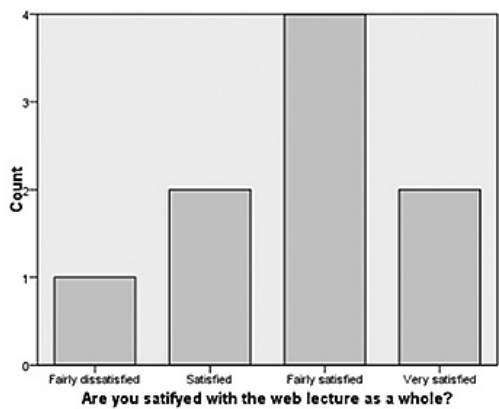


Figure 32. Satisfaction with web lecture

The majority of the respondents would like to take another web lecture on a topic of interest to them and two were not sure. All but one changed the way he/she searched the WWW after finishing the web lecture to different degrees, although all of the respondents felt that they became better at searching after finishing the web lecture.

8.4.4 Web logs

The web log data was from an eight month period, and throughout this time-span the web lecture application was visited 109 times and the users stayed for a total time of 20 hours and 44 minutes. The average stay per active day (46 days in total) was 27 minutes. The users were mostly active at the beginning of the week with a big dip in activity on Fridays. Contrary to the pilot study there was some activity during the weekend, although very little (Figure 33). In conformity with the pilot study the activity was lower in the afternoon than before lunch. However, in the 2nd round there was a clearer pattern of activity at the beginning of the workday and in connection to lunch with a break around 9 and 10 AM (Figure 34).

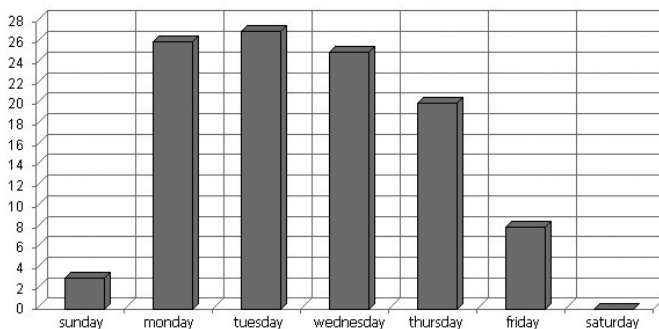


Figure 33. Visits by day of the week 2nd round

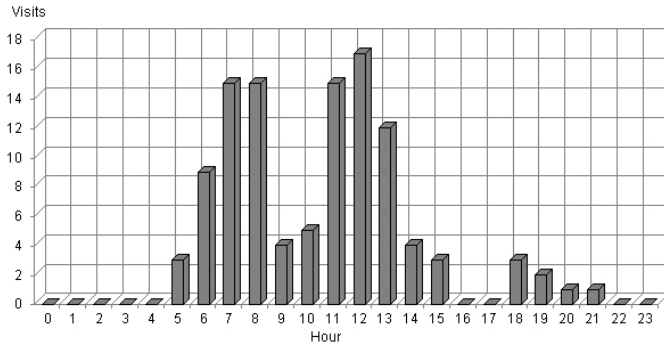


Figure 34. Visits by hour of the day 2nd round

In the 2nd study the frequency of the interaction patterns was distributed as shown in figure 35. Comparing to the interaction patterns from the first cycle, the distribution is similar except for single module (SM) with only 7% of the employees’ visiting the WLA and look at just one module and then leave.

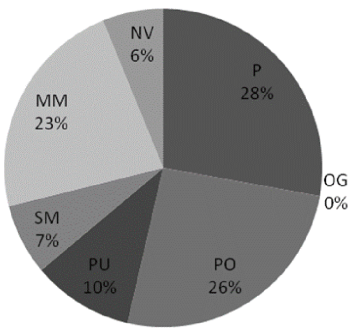


Figure 35. Chart all interaction patterns 2nd version

The distribution of the interaction patterns from the second version with the video interaction parts only is shown in figure 36. No new interaction patterns emerged in

the analysis of the evaluation phase of the Exploring Incentives and motivation for Collaborative learning cycle.

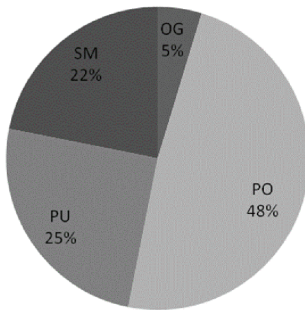


Figure 36. Chart with video interaction patterns 2nd version

The evaluation of the web lecture applications suggests that authentic e-learning (Herrington et al., 2010) needs to be modified when applied to e-training solutions such as “How to search the WWW”. The authentic e-learning framework is intended to guide the design of effective and immersive learning environments both for face-to-face and technology mediated courses. Looking at the implications for design of technology and mediating authentic e-learning in a work-integrated setting, some elements of authentic e-learning become peripheral depending on the purpose, scope, and the characteristics of the learning activity, whereas others become central. This is not to say that the peripheral elements are peripheral in the learning process as a whole, e.g. collaboration and articulation promote reflection and critical thinking, which are central to the learning process. In this case employees did not feel the need to collaborate with others participating in the same course, but the interviews revealed that some discussed what they had learned both at work and outside of work. This fact could explain why they did not feel the need for collaboration to be mediated by the web lecture application.

What is often assessed in a school context is the extent to which students are able to reflect upon and apply what they learn. Providing for the opportunity to be effective performers with acquired knowledge should be the natural goal for practitioners. To seamlessly integrate assessment with this activity is sensible in a school context, but in a work-integrated context it is more of a self-regulating process. The fact that the majority of the participants in both evaluations state that they have learned something new and have changed the way they search for information indicates they have reflected upon and applied what they have learned to their work practice. Adapting authentic e-learning to the conditions of e-training calls for a simplification of the framework. Articulation, Collaboration, and Integrated Assessment becomes peripheral when developing e- training systems.

8.5 Conclusion

The data from this cycle underscores the results from the previous cycle. There are correlations not only between learning outcomes and use-patterns, but also between interruptive use, explorative use, and perceived learning outcomes. The quotes from participants reported above illustrates this and the author concludes that the tentative design principles suggested in cycle two are further validated. The fact that the same patterns emerge in two consecutive evaluations constitutes a strong indication of the validity of the principles (Emergent principles #II and #III).

Furthermore, the evaluation of the third design research cycle points to an additional set of emergent confirmed and adapted design principles. The interviews clearly indicated that the lack of traces of collaboration and discussion in the WLA was mostly explained by the fact that participants preferred to reflect and engage in

conversations with colleagues in the local work context. Consequently, the need to support collaboration and reflection through design could not be validated in an e-training context. Instead, the results indicate that design should promote learners to reflect on their learning through collegial interaction. In relation to the original framework of authentic e-learning (Herrington et al., 2010), this design principle is adapted from Collaborative construction of knowledge and Articulation (Herrington et al., 2010).

Principle #IV (Adapted):

Design to promote learners' reflections with peers in their local workplace context.

Moreover, the responders demonstrated a variation in their existing knowledge and expertise with respect to online information retrieval prior to the e-training. Consequently, the design should support and promote a rich set of scaffolds that are adapted to the variation of learners' zones of proximal development (ZPD). As a consequence, the need for real-time interaction with an instructor could be reduced to a minimum. The interviews also show how the relevance of tasks and activities are important for participants' motivation. This design principle is adapted from coaching and scaffolding and reflection (Herrington et al., 2010).

Principle #V (Adapted):

Design for reflection and variation in participants' levels of expertise, so that scaffolding is integrated into the design.

The questionnaire further stresses the importance of providing an authentic context with activities and tasks that reflect the reality in all the performed exercises where they were urged to reflect and apply the new knowledge to their work practice. This in combination with the fact that all participants assessed that they learned something new leads to the conclusion that the following design principle from the original framework of authentic e-learning is validated:

Principle #VI (Confirmed):

Design for a learning environment that provides an authentic context through authentic activities and authentic tasks.

In the WLA, the learners could watch an expert demonstrate a variety of search techniques before using the techniques themselves. The interviews revealed that the participants valued the fact that the content of the course was relevant in relation to everyday practice of the county administration and stressing the importance of professionalism and “their way of doing things” which advocates the use of experts that represents organizational culture and ethics. This suggests the following design principle, adapted from the original principle of expert performance (Herrington et al., 2010).

Principle #VII (Adapted):

Use experts that reflect the ethics and the culture of the organization as content providers.

During the interview process it became evident that the learners had not initiated the learning process by visiting the WLA although they wished and intended to.

Furthermore, the large numbers of the “peeks” (user-pattern labeled as peeking) show how users’ intentions to engage in training can be challenged by the realities of everyday work. This indicates that the design should support user attention, alerting the learners to engage in the training so that competence development is put at the front of the organizational agenda.

Principle #VIII (Emergent):

Design for attention through gentle reminders to counteract procrastination.

9 Fourth Cycle - Translating the Design Concept

The final design research cycle was a proof-of-concept for the Web Lecture Design Concept. In this fourth cycle the adaptations of the authentic e-learning framework, and the design principles derived from the first three cycles could be further evaluated. Furthermore, in this cycle another team of designers utilized the design framework, where the author did not affect how they interpreted and realized the design framework.

9.1 Awareness of problem

Another WLA was to be developed by the IT department at the county administration of west Sweden. The reason for this was that the county administration was migrating to one common IT milieu on a national level at the time of the study. This meant that e.g. using Microsoft Outlook as the only email client throughout the organization instead of e.g. Novell's GroupWise which some counties used. For some counties this meant a big change in reference to system beings used in the everyday practice and for others already using a lot of the systems being implemented in the new common IT milieu it only meant minor changes. To prepare the employees' throughout the different counties for this change of IT milieu a WLA would be developed and made available to them before the new IT milieu would be implemented.

9.2 Suggestion

The authentic e-learning and GUI framework together with the findings from the second cycle were presented and discussed with the developing team during a workshop at the county administration of Western Götaland. The team had decided to design and develop the WLA according to the design principles of authentic e-learning. The development team would also address the problem with collaboration and articulation by encouraging the employees to discuss any questions they would have with colleagues.

9.3 Development

Visibility is one of the principles of good design suggested by Norman (1988) meaning that all the things you can do in a system should be visible, and it should be clear where in the system you are. The IT milieu WLA was divided into six modules, “Introduction”, “This is the new IT milieu”, “Computer and programs”, “How to get help & support”, “Changes to certain groups” and “What you need to do yourself”. As shown in Figure 37 these are all visible from the main menu, where the employees get an overview of what the topics are.

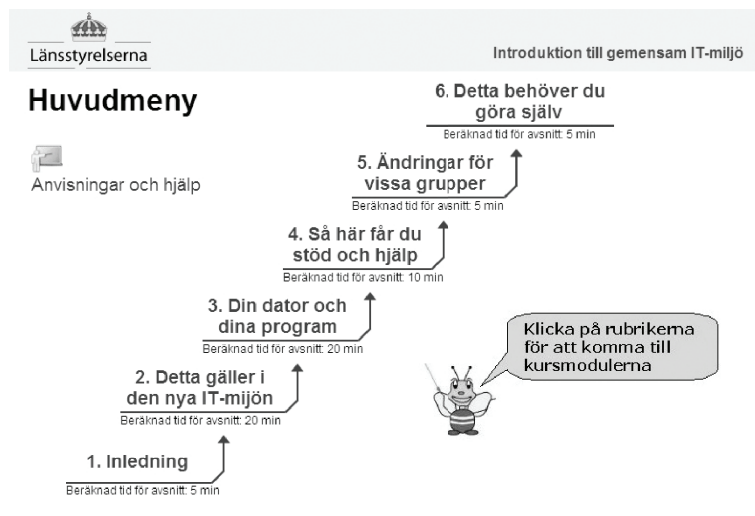


Figure 37. The main menu for the IT-milieu web lecture application

Each module was estimated to take from 5 to 20 minutes to carry out and consisted mainly of pictures and text. Dominating topics were IT security, program functionality, and public storage of files and new routines that applied after the implementation of the IT milieu. From the main menu one could also reach the instructions and help page with a short introduction of the purpose and who to contact if help was needed (Figure 38).



Figure 38. The navigation for the IT-milieu web lecture application

The navigation was placed at the bottom of each page as illustrated in Figure 38. From the navigation the employees could reach the main menu or go back to the

table of contents for the section the employees were currently engaging with. To the bottom right the employees could also go to the next page or go back to the previous. The clear green arrows and the choice of words in the text links (e.g. Main meny) make it easy for the employees to determine what will happen before they click (Norman, 1988; Roger et al., 2011). The entire navigation scheme is not present at all times as it is in the searching the Internet WLA because the amount of pages did not allow for that. If the employees wanted to jump to another section than the next or the previous they had to go via “Main menu” or “This sections table of content” (Figure 38). In this way the navigation takes up less than 20% of the available space giving the content more than 80% of the space (Nielsen, 2000).

In order to increase the readability, the text was a black sans serif font on a white background and sentences were not longer than 60 positions. The contrast between the white background and the black text makes it easier to read, and the length of the sentences ensure that the reader do not lose track when they go to the next sentence (Nielsen, 2000). Like the searching the internet WLA, the IT milieu WLA was adapted for a screen resolution 800x600 pixels to fit the lowest standard of resolution on computers at the county administration of Western Götaland.

This introduction is designed for individual studies and to be the lowest common denominator of what you need to know before the transition to the new joint IT environment.

Before the transition to a new joint IT environment, there is on each county administration a local implementation group that will be responsible for answering questions and issues not covered in this introduction.

The introduction material consists mainly of:

- Text and images
- Demonstrations in Flash format
- Manuals in Web format
- Voluntary self-tests
- In depth sections
- Reflection questions



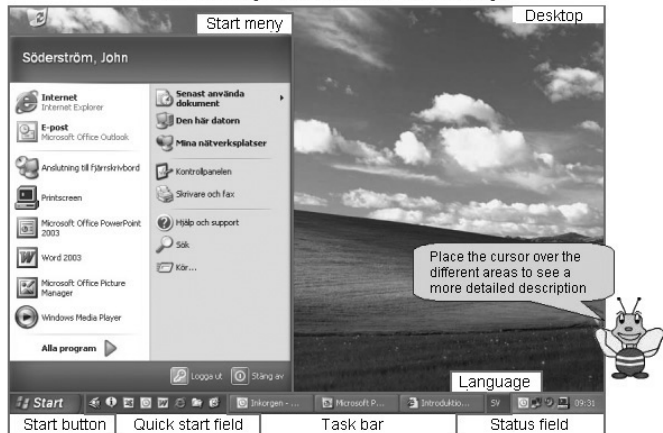
In some of the modules you are shown how to do step by step. You move on to the next step by hitting space. By dragging the cursor on the time line you can reverse or fast forward the demonstration. An alternative to the demonstrations are the manuals

Questions about the course, is referred the introduction group at each county administration. If you have comments on the introductory material please send an e-mail the following address: it@o.lst.se

Figure 39. The instruction and help page

There were voluntary exercises at the end of a module or inside the modules where the employees were encouraged to reflect upon the module and sometimes test if they had understood correctly, e.g. what characterizes a strong password and what types of passwords are weak. Some of the self-assessment tests were multiple choice tests.

Your computers new desktop



Main meny This sections table of contents

Page 10 of 27

Figure 40. Screen dump from one of the modules in the IT-milieu web lecture application

The employees get continuous feedback (Norman, 1988; Roger et al., 2011) on their current section and what page they are on in the upper right corner of each page and how many pages the section consists of in total in the lower right corner. As shown to the bottom right in figure 40, the section is Computers and software and the page is number 10 out of 27 pages.

In the following section the design rationale for the IT milieu WLA is described. The design is based on the adapted framework by Herrington et al., (2010) that was presented to developing team leaders at the county administration academy. The development team from Western Götaland then developed the IT milieu WLA to be

made available to the employees at Karlskrona in Blekinge County six months ahead of the implementation.

An authentic context that reflects the way the knowledge will be used in real life

An authentic e-learning environment should provide an authentic context that reflects the way knowledge will be used in reality (Herrington et al., 2010). All the examples and descriptions mimicked what it would look like in the new IT-milieu. In some cases the employees could even see and test on their own computer what things would look like and how new tasks were to be carried out in the new IT-milieu. Herrington et al., (2010) encourage designers of learning environments to embrace the complexity of the real life situation and be cautious of oversimplification of real life complexity. The examples used in the IT-milieu WLA were real life examples shown in their entirety and not broken down into smaller steps.

Authentic activities/tasks:

An authentic e-learning environment should also provide ill-defined authentic activities that encourage students to find and solve problems (Herrington et al., 2010). The examples used are from their everyday work practice but generally described. The employees are encouraged to think about how it will apply to their own situation, e.g. the new password standard is described on a general level like:

Your new password must

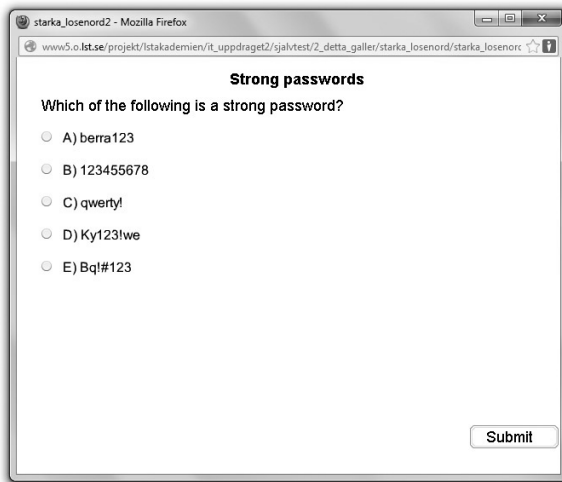
- Consist of at least 8 characters
- Must contain at least one of the following 3 types of characters:
 - Upper case letter/s

- Lower case letter/s
- Special characters e.g. @\$#%&()*
- Cannot contain your user name or parts of your first or last name

The employees are then encouraged to figure out a new password that fits the new password standard.

Authentic assessment

An authentic e-learning environment should provide for integrated assessment of learning within the tasks (Herrington et al., 2010). Throughout the IT milieu WLA, questions and a multiple choice test (Figure 41) are used to help the employees assess if they have understood the topic of the previous section.



The image shows a screenshot of a web browser window titled "starka_losenord2 - Mozilla Firefox". The address bar displays the URL "www5.o.lst.se/projekt/stakademien/it_uppdraget2/sjalvtest/2_detta_galler/starka_losenord/starka_losenord". The main content area has the heading "Strong passwords" and the question "Which of the following is a strong password?". Below the question are five radio button options: A) berra123, B) 12345678, C) qwerty!, D) Ky123!we, and E) Bq!#123. A "Submit" button is located at the bottom right of the form.

Figure 41. Example of an exercise

The employee could then self-assess whether or not they had understood the content and could go to the next section or if they had to go back and re-visit the previous section or parts of it one more time.

Access to expert performances and the modeling of processes

Authentic e-learning environments provide access to expert performances by letting students observe a task before they try it themselves (Herrington et al., 2010). In the IT milieu WLA experts from the IT department within the county administration had developed all the material. This means that the employees get access to the modeling of experts who know how the new systems work.

Collaborative construction of knowledge

An authentic e-learning environment supports the collaborative construction of knowledge (Herrington et al., 2010). As was the case with the searching the WWW WLA, the flexible character of workplace training makes it difficult to support and promote real-time collaborative learning since it is very uncertain how many employees will be active simultaneously. Although in the case of the IT-milieu the employees engaging in the WLA were located at the same place. This means that there is a greater opportunity to collaborate and in the WLA the employees are encouraged to discuss different issues and questions with colleagues at the end of the sections.

After this section you should have an over view of how your computers programs will look like in the new IT-milieu.

Things to think about:

- How do the changes in the new IT-milieu affect you?
- Which are the new opportunities that arise now that all the calendars of the county administration are shared?
- What will your e-mail address and user name look like in the new IT-milieu?

Please discuss these questions with your colleagues.

Figure 42. Reflection and collaboration questions rounding up section 3, Computer and software.

Coaching and scaffolding

An authentic e-learning environment provides for scaffolding of support and coaching at critical times (Herrington et al., 2010). During the period leading up to the implementation of the new IT systems each county had a local implementation group. This group would handle any questions the employees would have concerning the IT milieu including the WLA.

Multiple roles and perspectives

An authentic e-learning environment provides the learner with the opportunity to investigate multiple roles and perspectives (Herrington et al., 2010). In the IT milieu WLA the different aspects of e.g. handling sensitive information is elaborated upon i.e. how to store it, not sending it through e-mail, be careful when printing and so on.

Reflection

An authentic e-learning environment promotes reflection to enable abstractions to be formed (Herrington et al., 2010). Throughout the IT milieu WLA the employees were encouraged to reflect upon how the changes that were presented would affect them. It could e.g. be questions at the end of a section asking: what will your new e-mail address be or what will a new strong password for you be. The suggestion to discuss with a colleague is also aimed at making the employees reflect on what they have learned.

Authentic assessment

An authentic e-learning environment should provide for integrated assessment of learning within the tasks (Herrington et al., 2010). When the employees e.g. are trying how to open a program in the interactive module shown in figure 39 they get feedback on whether or not they understood it right when the employee is successful or not in opening the program. The self-assessing process also continued when the new IT-milieu was implemented, and the employee tried to do things they learned through the WLA.

9.4 Evaluation

The IT milieu WLA was made available for the employees to engage in six months before the planned implementation. Due to the fact that the IT department needed more time to prepare, the implementation was delayed a couple of months. On the day of the implementation the author was at the site in Karlskrona to evaluate the WLA through interviews with 18 employees. Firstly, the primary objective of the evaluation was to assess to what extent the design framework could be interpreted and utilized by a professional team of developers. Secondly, it was a test to see how

the web lecture design concept could be translated from searching the WWW to a WLA with a different content.

The interviews were semi-structured and ranged from 3 to 24 minutes and on average lasted 9,5 minutes. The interviews were recorded with the respondents' permission and stored electronically as mp3 files. The transcription was outsourced to a professional transcriber. The transcripts were mounted and coded using ATLAS.ti. The interviews evolved around the same themes as in the evaluation of the previous cycle, i.e. employees' prior experiences with the WLA and what, if anything, affected their experiences. They were based on a semi-structured interview guide with the sub categories of:

- Work context
- Computer experience and previous interaction with e- training systems
- Interaction with system, how they took part in the web lecture.
- Interaction with peers
- E- training vs. face-to-face learning
- Summaries
- Modularity

Most of the interviewees were administrators and coordinators working with e.g. writing reports, newsletters, and updating the official web site.

“I use my computer mostly for budget planning and keeping track of the budget. To write reports. I use Arkis or rather Arkview but Arkview is soon to be replaced by Arkis. Arkview or Arkis is software

for creating maps to use in the reports. To better illustrate the material we have collected from nature”

“I really do not work with anything else than my computer. Since I work as a finance manager it is our accounting software I mostly use. Also Excel, Internet, and the email client.”

Seven had attended face-to-face courses before, and for six of the interviewees this was their first e- training experience.

These interviewees also talked about the need for a push to get started. As one of the respondents put it:

“But you had better make time, like I said before, I think it is [paus. Authors note], you are better off in the long run. But if you come here to make a PowerPoint presentation or something and make it mandatory. Then it is harder to avoid it. Because in that case you will attend the presentation. Otherwise it is unfortunately easy to let it go.”

The above quote also points to the lack of time being a factor. Another respondent stated that it is easier to put things off that are not mandatory and only focus on one's own deadlines and prioritize the daily work. This is the case even if it is obvious that taking the web lecture would be beneficial. The opportunity mentioned

is because the respondent could not log on to his/her computer and take the web lecture with a colleague:

”Interviewer: One of the problems I have seen with e-learning is that [pause. Authors note] it would have been good to have time for it but since it is not mandatory and it is flexible it is easy to...

Respondent: ...do it later, yes. Now we got an opportunity, otherwise I do not think I would have done it.”

One of the respondents when discussing another e- training activity he had seen:

”just sitting and watching video sequences, it is not so pedagogical. It is better if you can test it yourself.”

Two colleagues took the web lecture together since one of them could not get her computer started. Although spontaneous and unplanned it turned out as a positive activity for both of them:

*“Interviewer: But it was easy to understand and everything?
[referring to the web lecture, Authors note]*

Respondent: Yes, I actually think it was. And if there was anything, then we would discuss it. But I do not recall us running into anything major...”

The other colleagues replied later in the interview and said:

"We watched all of it and when we for instance came to the part with the email, which was new to us, we opened up her email and compared. And then we tried to send emails to each other and to others as well and checked if it was possible to create groups and add new addresses and so on."

When asked about e-training in comparison with face-to-face learning, one interviewee responded:

"The advantage with this [referring to the web lecture. Authors note] was that I could quickly scan through those parts that I felt I was already familiar with and then focus on the parts that were new to me."

The wish for summaries in the form of cheat sheets of the sections to print out or go back to also came up in the interviews.

"Interviewer. But the way Outlook was presented, the section about how you create maps and organize and how you sort the address book. Would you have liked cheat sheets where you could read more on your own?"

Respondent. Yes, a cheat sheet.

Interviewer. That you could bring back up and...

Respondent. ... because I think it is important that it works correctly and that your structure is in order. I could probably figure it out.

Interviewer. Yes, but there is no use wasting time on that when there are people who know how it is done and can easily explain it.

Respondent. Well, I would have liked a cheat sheet.”

The majority of the interviewees skipped parts that they deemed unnecessary mainly because they felt they already knew what was in the module.

9.5 Conclusion

The translation of the web lecture design concept from “Searching the WWW” to “New IT milieu” worked to satisfaction. The author found that the manner in which the design team from the IT department of the county administration of Western Götaland interpreted and realized the design principles were satisfactory. Moreover, the interviews underscore the validity of the design principles derived from previous cycles of design research.

Watching how e.g. the new email client works and then trying to create email groups and send an email to a colleague that sits next to you, points to collaborating on an authentic task where the employees reflect and articulate new knowledge gained

through access to an expert performing the task in an authentic context. Then evaluating the outcome, whether or not the employees successfully sent an email or not gives them assessment on whether or not they have understood and are able to apply the new knowledge.

Interviewees also talked about the need for a reminder or some kind of push to get started while mentioning the lack of time being a factor influencing how and when they took part in the learning activity. This indicates the need for a flexible WLA where it is also possible to quickly scan through what parts the employees were already familiar with and need not look at.

10 Design principles for e-training

As we move from an industrial society to a knowledge society learning becomes increasingly important (Appelbaum and Gallagher, 2000; Teräs et al., 2012). Learning is no longer confined to institutions such as schools, formalized in a classroom environment, but rather is part of a lifelong journey (Edwards et al., 2006). The transition from school to the workplace becomes increasingly difficult due to rapid changes of the competencies needed in the digitalized and automated workplace (Sørensen, 2016). This is highlighted in a study by Moore and Greenland (2016) where a strong connection between professional learners failed to complete their competence development in online higher education due to work commitments. This finding further stresses the need for design knowledge that guide the design of e-learning and e-training solutions that is adapted for learners with work commitments. To address this fact, design principles from the school domain have been applied to the problem of designing information technology to support workplace training and thus extend a known solution to a new problem as an exaptation (Gregor and Hevner, 2013).

Through four cycles of design research (Vaishnavi and Kuechler 2004, 2008), a design concept for e-training through web lectures has evolved and matured. The cycles have generated a set of eight design principles for workplace e-training. Three of the design principles emerged from the design cycles, and five design principles originated from the kernel framework of authentic e-learning (Herrington et al., 2010), and were either confirmed as transferable to the context of workplace e-training or adapted to comply with the conditions of e-training in a workplace such as the county administrations of Sweden. The principle of authentic assessment

from the original authentic e-learning framework has not been included in the design framework for workplace e-training, since the empirical data from the cycles of evaluation could not validate its claims.

The next section presents and explains the design principles for e-training. When presenting the design principles, the notation for design principles described by Chandra et al. (2015) is used. This means that the presentation contains statements about what the WLA should enable the learners to do and how the design principles should be applied to accomplish clear design principles (Chandra et al., 2015). The user group and the boundary conditions under which the design principles will work are described in a section of its own to avoid repetitious descriptions of the user group's characteristics. Then the unconfirmed principle of authentic assessment from the original framework of authentic e-learning is accounted for, thereafter the class of problem is defined. Subsequently, follows a discussion about organizational factors affecting the success of e-training. Next the methodology of this thesis is related to the ADR framework of Sein et al. (2011) together with an account for evaluation of e-training framed by Venable et al. (2014). Before the conclusion, current research trends in e-training are discussed in relation to design principles for e-training.

10.1 Design for e-training

In this section the design principles of e-training through web lectures will be presented and discussed with respect to how they should be applied. First the principles are outlined in table 27 in the same order they appear in the thesis. To the right in table 27, pragmatic design guidelines for the corresponding design principles are presented.

Design principle	Design guidelines
Principle #I (Emergent)	Design the e-training so it adheres to the limitations and opportunities of the organizational and infrastructural context to facilitate implementation and maintenance.
Principle #II (Emergent)	Design to support for interruptive use, so that learners are supported in prompt repetition of previous use-sessions.
Principle #III (Adapted)	Design for explorative use so learners can create flexible and individual use-patterns.
Principle #IV (Adapted)	Design to promote learners' reflections with peers in their local workplace context.
Principle #V (Adapted)	Design for reflection and variation in participants' levels of expertise, so that scaffolding is integrated into the design.
Principle #VI (Confirmed)	Design for a learning environment that provides an authentic context through authentic activities and authentic tasks.
Principle #VII (Adapted)	Use experts that reflect the ethics and the culture of the organization as content providers.
Principle #VIII (Emerged)	Design for attention through gentle reminders to counteract procrastination.

Table 27. The principles of e-training through web lectures with corresponding design guidelines.

The notion of scaffolding in the original kernel theory of authentic e-learning framework (Herrington et al., 2010) refers to the teacher or a more able partner that

assists with scaffolding or coaching when students collaborate or need assistance with a problem. They touch upon computer-based resources being able to provide scaffolding but refer to Collins et al. (1989), when concluding that scaffolding is highly situation-specific and is best performed by a teacher. This may be true, but it is argued here that the notion of scaffolding is wider and can be provided by technology (Puntambekar and Hubscher, 2005). Scaffolding is not only restricted to interactions by individuals at different skill levels, it can also occur when interacting with a digital environment (Hill and Hannafin, 2001).

Since the basic idea of the WLA is to support the employees in their learning process and in different ways guide them towards internalization of the knowledge so they can apply it in other contexts, it makes sense to use scaffolding to organize and characterize the design principles of e-training through web lectures. Besides this, the concept of scaffolding has strong roots in the tradition of socio-cultural learning (Vygotsky, 1978), and well implemented scaffolds positively influence the learning process (Gupta and Bostrom, 2009). Although design principle #VI concerning authenticity could be characterized as a scaffolding principle, this principle forms a separate category to underscore the importance of authenticity in e-training. To this end, the four key components of scaffolding by Hill and Hannafin (2001) are used to categorize e-training through web lectures along with authenticity. The structure is as follows: *Authenticity*, *Metacognitive scaffolds*, *Conceptual scaffold*, *Strategic scaffolds*, and *Procedural scaffolds*.

10.1.1 Authenticity

Principle #VI: Design for a learning environment that provides an authentic context, authentic activities and authentic tasks.

When providing an authentic context, the learning content should reflect the context the knowledge is used in and the way the knowledge is to be used (Brown et al., 1989). This could come naturally when developing substantial web lectures in and for the workplace, but needs nevertheless to be emphasized. The content should provide cues for the learners' memory to make the acquired knowledge more memorable (Norman, 1988). In both cases in this study, the tools and application that were used for the demonstrations mirrored the tools and application of the employees' work practice. This means that before the web lecture content is created the designer needs to learn about where and how the knowledge will be used. What are the knowledge, skills, and attitudes the learners should have after completing the web lecture, and how should they be applied? The amount of time and effort for this is of course dependent on whether the designer of the learning content is from within the organization or not.

The designer of the learning content should also avoid over simplifying complex cases and situations (Herrington et al., 2010), but rather keep the complexity of the real work setting. To ensure an authentic context, the tools, applications, and processes should reflect how they are used in an appropriate environment using concrete examples (Santhanam and Sein, 1994) without over simplifying how processes and tasks are depicted (e.g. Honebein et al., 1993).

The activities and tasks within the WLA should also mirror real-life activities. While this might seem obvious, the authentic activities, e.g. exercises, should be ill-defined or described at a low level, so that the employee is encouraged to find and solve problems from their own work practice (Brown et al., 1989). In the case of searching the WWW the clear majority of the employees did at least some of the

exercises and if they did an exercise they did it when it was suggested by the web lecture. To achieve this behavior, designers need to strive for tasks and activities to be interwoven with work practice and daily duties. This could be achieved by designing exercises and tasks in the WLA so that the employees reflect on how this new knowledge applies to solutions to problems from their work practice.

10.1.2 Metacognitive scaffolds

Principle #V: Design for reflection and variation in participants' levels of expertise, so that scaffolding is integrated into the design.

It is important that e-training allows employees time for the process of learning and reflection (Paulsson et al., 2005). Reflection is at the core of all learning activities (Ramsden, 2003), making it important to create content and interaction that encourage reflection. To encourage reflection, the authentic tasks and activities need to require decision making. In this way, the employee needs to reflect on various solutions to a problem by reflecting in action (Schön, 1983). These solutions are then tested and the employees modify their actions according to the nature of the outcome, i.e. if the problem was solved or not. For the employees to develop competence there needs to be an interplay between formal and informal learning (Svensson et al., 2004), where the formal knowledge and skills gained through e-training are integrated into practice through everyday work (Slotte et al., 2004).

The designer also needs to consider the individual levels of the ZPD (Vygotsky, 1978), i.e. the ZPD span might be wider or narrower depending on the previous knowledge and experience the employees bring to the learning activity and give the learner the right task to keep them engaged and motivated (Davis and Bostrom,

1994). The e-training environment should therefore provide the opportunity to skip parts that the employee can do without the aid of the e-training system and in this way, support the employees to self-regulate the learning process (White et al., 2000).

Principle #IV: Design to promote learners' reflections with peers in their local workplace context.

In the context and setting of this framework, the active coaching role of a teacher is not as important as it would be in a school setting. According to Herrington et al. (2010) the accommodation of coaching is done principally by the teacher and in some cases the students help each other. Herrington et al. (2010) do not, however, believe that e-learning and e- training can be a self-contained resource, but rather that coaching assistance should be available for a significant portion of the time by teachers and more able partners. However, the empirical data in this thesis show that the employees did not feel the need for coaching and scaffolding by the teacher/expert responsible for the WLA or by other geographically dispersed employees, who also were engaged in the same e-training activity. If they needed assistance or collaborated with others, it was primarily through reflection-on-action (Schön, 1983) with other peers in their proximity.

To discuss with a colleague is more naturally integrated in conversation that would have taken place anyway. This illustrates how the interplay between formal and informal learning creates competence (Svensson et al., 2004), when the employee reflects on the formal learning from the e-training and informally shares this with a colleague. E-training should encourage and create an arena for both individual and joint reflection between colleagues to facilitate competence development of the

individual and of the workplace as a whole. In other types of e-training, e.g. case based team building through an e-project (e.g. Cheng et al., 2015), collaboration and CSCL technology are essential, but it is argued here that the importance of supporting the sharing of narratives and stories is of less importance in e-training situations with self-regulated e-training. The data from this study as well as other research (Kwakman, 2003) indicate that reflection still takes place.

Collaboration is a well-known catalyst for reflecting (Herrington et al., 2010), since the learner needs to articulate the new knowledge, a process that will further develop the understanding of the newly gained knowledge. Learning activities at work are often ‘semi-formal’ and planned where employees learn from and with each other (Tyjälä, 2013), but collaborative activities inherently come with coordination costs and interdependencies between participants that constrain flexibility for the individual learner (Kwakman, 2003). A common frustration in workplace learning is the time-consuming e-mail that encourages collaboration in discussions on threaded forums that sometimes are forced upon learners (Driscoll, 2002).

It is thus suggested that e-training should encourage optional collaboration by e.g. providing guided discussion points. Even though it was not successfully implemented in this study, communication tools such as discussion boards and wikis might have been used if they were naturally used by other colleagues. Collaboration between colleagues can also help reduce perceived anxiety (Gupta, 2017). Appointing a peer at times where large groups undergo an e-training initiative during the same time period could also be one way of adding a collaborative element, as with the IT milieu case where that happened spontaneously. When implementing system/s, as in the case with the IT milieu, some experts from the IT department could also be appointed as a local resource if time and resources allowed

it. Employees regularly need to teach their colleagues or be taught by them in informal and unplanned ways (Tyjälä, 2013).

10.1.3 Conceptual scaffolds

Principle #VII: Use experts that reflect the ethics and the culture of the organization as content providers.

Employees learn through everyday work activities by observations or imitation while working with others (Billet, 2014). This can be utilized in e-training by engaging internal or external experts, so that employees can watch how an expert performs a task before trying it themselves (Collins, 1991). In this way employees observe expert performances in a way that mimics the old apprenticeship system of learning (Brown et al., 1989). The expert is also knowledgeable about the topic and can provide hints and relationships among key concepts and in this way help the employee decide what is important for his/her own competence. This also enables the employee to better create conceptual models which will enhance performance (Santhanam and Sein, 1994), when the employee turns knowledge into action. E-training then makes it possible for an expert's performance to be deployed throughout an entire organization.

The access to experts can also help strengthen the organizational culture through the sharing of narratives and stories and can even help inaugurate new employees to the organizational culture and “the way we work here”. Employees sometimes unconsciously pick up bad behavior from other colleagues (Slotte et al., 2004), which can be countered by using experts that represent the company culture. This can also counteract the possible negative attitude employees can have towards

receiving policy information on screen when the employees just want access to relevant information (Newton et al., 2002). This stresses that the attitude of the experts should reflect the ethics and the culture of the organization.

10.1.4 Strategic scaffolds

Principle #III: Design for explorative use so learners can create flexible and individual use-patterns.

Having more than one set of learning materials is suggested to enhance the learning outcome (Xu et al., 2014). Similarly, access to multiple perspectives can help employees better understand and get a deeper understanding. If learning material illustrating the content from different perspectives all have to be created by the developers, it could be costly and time consuming, but in this case, resources on the WWW were used as an additional resource. A feedback process can also help generate different perspectives on a topic area (Walker and Arnold, 2003), but is more likely to succeed in e-training environments where there is a critical mass and a possibility to schedule learning events.

It is also important to tailor the training method to different individual learning styles (Bostrom et al., 1990). Using Kolb's (1984) terminology for the four learning styles to exemplify, an accommodative learner prefers active experimentation and involves his/herself in new experiences by solving problems intuitively. Accommodative learners would then benefit from e-training that is characterized by experimentation and discovery by providing multiple perspectives (Bostrom et al., 1990). Multiple perspectives could also mean engaging the same learning material but with different mindsets or from different viewpoints, e.g. watching a video of a

scenario several times but focusing on different details or aspects. The multiple perspectives and variations in how the learner can interact with the learning material can also promote curiosity and increase intrinsic motivation (Davis and Bostrom, 1994). The employees should therefore be given the opportunity to investigate the topic from more than one single perspective and be provided the opportunity to go back and forth in the learning environment and other resources.

10.1.5 Procedural scaffolds

Principle #I: The limitations and opportunities of the organizational and infrastructural context must be carefully considered as a frame for the design of e-training.

The first prototype of the WLA needed a plug-in to be installed on the employees' computers to run. When the prototype was demonstrated at a workshop with representatives from the county administration, it was clear that it would be too costly time-wise to install plug-ins on computers. Either the plug-in had to be installed on all computers as anyone in the organization could enroll in the web lecture, or the IT department had to install the plug-in on the computers of employees who enrolled. This would suggest that, prior to building the WLA, the designer must consider what the most appropriate and lean technologies are without sacrificing the pedagogical approach. In this way unnecessarily burdening the implementation process and the maintenance of the system are avoided. This is also to protect the employees from technical issues while interacting with the WLA.

Principle #II: Design to support for interruptive use, so that learners are supported in prompt repetition of previous use-sessions.

This principle could on the surface appear to be the same as designing for flexibility, but interruptive use here refers to employees being forcibly interrupted by work related activities and then needing to easily go back to the WLA and pick up where they were. Clear instructions regarding how to find various course components is one of the factors that is rated as important to learners' success in online courses (Ralston-Berg, 2010). Except for Friday, the visits were evenly dispersed over the week, but during the day there were peaks in the morning hours and around lunch time. The morning peak could indicate that the learners more or less start the day off with the web lecture before the workload sets in. The peak around lunch hour could also indicate that employees utilize the natural break for lunch to engage in learning activities. This paints a picture of work tasks controlling when learning activities take place and thus suggests that the modules that make up the web lecture need to be fine-grained, i.e. short video clips (Nielsen and Loranger, 2006) so the learners do not need to waste time having to watch parts of a video clip while waiting for the part of interest or having to fast forward.

A clear and logical structure with navigational aid and clear instructions on where to go and what to do next, so the learner can find their way back accurately and fast, is crucial for successful learning (Grandzol and Grandzol, 2006). The need for this is also evident in the surveys and the interviews. The survey shows that four out of nine learners had returned and re-watched parts of the web lecture and 6 out of 9 divided the web lecture into two or more sessions. In the interviews six out of nine said they considered going back to the web lecture in the future and six were interrupted by work while doing the web lecture. Furthermore, when the employees

e.g. do an exercise they relate the new knowledge and its definitions and relationships with their existing knowledge (Anderson, 1982). This process can be slow since the employees have not yet specialized the decision rules for the problem domain (Ahrens and Sankar, 1993). This further confirms the need of control over the pace of learning and provides easy access to the learning material to facilitate a high level of interaction with the objects of learning (Santhanam and Sein, 1994).

It can be argued that reproducing digital learning material to keep down the cost is an important aspect of e-training and a clear structure facilitates reusing material with a low effort. This fact combined with the use of learning objects can improve the reusability even further (Agaba and Lubega, 2016; Biletskiy et al., 2009). A limited budget is the stark reality for many designers of e-training systems and content that cannot be overlooked. The clear structure of digital learning material does not go against a sound pedagogical approach and still keeps the option to partake of larger parts of the learning material if desired. The learning material should be structured in a way that makes it possible for the employees to choose how they want to interact with the WLA, i.e. do it in one go or on several occasions. It should also be easy to revisit certain parts of the learning material e.g. if the employee wants to review something.

Principle #VIII: Design for attention through gentle reminders to counteract procrastination.

Another aspect that came out of the interview process was the fact that some participants needed a push to direct their attention to the e-training activity. When some of the employees were contacted for the interview, they said that they had not had time to do the web lecture yet although they would very much like to. They

asked to be contacted in a couple of months and when contacted, they had all finished the web lecture. The problem of “not getting it done” because of the flexible, nonscheduled nature of the e-training was also expressed in the interviews. When taking on e-training at work, it is inevitable that the learners are divided between their work and daily routines and the learning activities. In work situations where informal work is supported by ICT the interaction with the systems are often more seamless (Lundin, 2006) than is the case with ICT systems supporting formal learning. This suggests the designer should incorporate a discreet reminder system or push to learning activities that employees have signed up for themselves. If there is a community of interest in place, a communication tool could also increase the awareness and counteract the procrastination (Bargeron et al., 2002).

10.1.6 The unconfirmed design principle of authentic assessment

The shortcomings of the assignment that was added to the web lecture application after the second cycle led to the rejection of the design principle of authentic assessment (Herrington et al., 2010). This is not to say that the research presented in this thesis conclusively falsifies the claims of the original framework of authentic e-learning (Herrington et al., 2010) with respect to authentic assessment – it merely provides a strong indication (given the efforts to translate this design principle into a concrete instantiation) that this principle should be rejected in the context of workplace e-training. Although looking at the theoretical underpinnings for the individual for the different design principles, authentic assessment is the only design principle from the original framework by Herrington et al. (2010) that is not rooted in the apprenticeship methods that Brown et al. (1989) and Collins et al. (1989) advocate.

Often when students are assessed in an academic context, it is to assess to what extent they can reflect upon and apply what they learned. To be effective performers with the acquired knowledge is also a natural goal for practitioners. To seamlessly integrate assessment with the learning activity is sensible in a school context, but not always in a workplace e-training context unless it is self-assessment. E-training in this case was a self-regulating process where the employees evaluate and assess their own learning outcome. The fact that the majority of the employees in the evaluations state that they learned something new and changed the way they search for information points to them having reflected upon and applied what they learned for their work practice. When an employee tests what was discussed in a module, e.g. how to use the minus sign when doing a search, they assess what they had learned and get feedback from the successful or unsuccessful outcome of applying what they had learned to a task.

When an assignment that resulted in a certificate was added to the web lecture application none chose to do it. One contributing factor to why no one chose to do the assignment is the relative low value of a certificate vs. future competence development. If employees are accredited with a document that is to be used for the employees' future competence development (e.g. Teräs and Herrington, 2014; Nilsson and Engström, 2015), then motivation to undergo assessment is higher.

Another factor mentioned in the interviews was lack of time. Even if the assignment was estimated to take no more than 15 minutes and was relatively simple, such as describing a search that they have done themselves and giving feedback on another colleagues' searches, it was not prioritized.

In today's knowledge-based economy, employees have a growing need to be able to integrate learning and competence development with everyday work (Tynjälä, 2008). The design principles for e-training hence need to be characterized by flexibility with respect to time and place of the workplace training and authenticity of the content and the tasks provided by the e-training system. The employees are to a large extent autonomous in their daily work, with freedom within the rules and regulations of their respective areas of responsibility. Based on this, the learning mode of e-training would then be web-based, asynchronous, self-paced, and individual-based (Gupta and Bostrom, 2009). This makes it possible for the employees to engage in the e-training activity when they see fit and when the workload allows it.

E-training through web lectures has no cohort of learners participating in the learning activities at the same time following a schedule like most institutionalized education does. The learning activities cannot rely on learners needing to interact or collaborate with each other at synchronization points in time (Lundin, 2006). Although it is highly beneficial, if there is a collaborative climate within an organization so the sharing and discussion of new knowledge gained from the e-training is more or less natural, this cannot be planned.

10.2 Class of problem

In this section the class of problems (Hevner et al., 2004; Gregor and Jones, 2007; Vaishnavi and Kuechler, 2008; Sein et al., 2011) is first clarified by describing the employees' characteristics and the context for the application of the design principles for e-training. Secondly, the class of problems is defined by clarifying the type of learning that the e-training framework aims to support.

In today's knowledge-based economy, employees have a growing need to be able to integrate learning and competence development with everyday work (Tynjälä, 2008). The design principles for e-training consequently need to be characterized by flexibility with respect to time and place of the workplace training and authenticity of the content and the tasks provided by the e-training system. The employees are to a large extent autonomous in their daily work, with freedom within the rules and regulations of their respective areas of responsibility. Based on this, the learning mode of e-training would then be web-based, asynchronous, based on individual self-regulated engagement (Gupta and Bostrom 2009). This makes it possible for the employees to engage in the e-training activity when they see fit and when the workload allows it.

E-training through web lectures has no cohort of learners participating in the learning activities at the same time following a schedule like most institutionalized education does. The learning activities cannot rely on learners needing to interact or collaborate with each other at synchronization points in time (Lundin, 2006). Although it is highly beneficial if there is a collaborative climate within an organization so the sharing and discussion of new knowledge gained from the e-training is more or less natural, this is challenging to design for.

Bloom identified six categories or levels of educational goals within the cognitive domain: knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, 1956; Krathwohl, 2002). Usually university courses aim at the low and intermediate levels of Bloom's taxonomy in the first years to end up at the higher levels in the final years. Learning objectives bearing the characteristics like those of searching the WWW and IT milieu do not need to reach the higher goals

of Bloom's taxonomy (Analysis, Synthesis, and Evaluation) to be valuable for the individual learner in a workplace training context. Being able to understand and apply new knowledge (knowledge, comprehension, application) from the web lecture to one's own work setting (e.g. searching for information on chemicals) is satisfactory. When gained knowledge translates into practice, employees' skills increase and they carry out work tasks more efficiently. However, the e-training principles should not be perceived as only supporting learners to be socialized into existing good practices, it also holds the potential of challenging the current practice resulting in exploratory learning (e.g. Svensson, 2004).

In summary, the e-training framework is a solution for autonomous and self-regulated employees, who need to integrate authentic and relevant learning that translates into attitudes and increased skills/competencies in a manner that adapts to their everyday work.

10.3 Organization of e-training

Since the focus of this thesis was on scaffolding the employees' learning process, other variables might have influenced the learning process, which has not been discussed in depth. This section highlights other contextual variables that are of importance for an organization engaging in e-training. Designing a learning and training environment according to the learners' needs is not enough for an e-training initiative to be successful (Newton et al., 2002). Aside from the e-training system, Burke et al. (2007) also identify external success factors such as learner characteristics and work environment. External influences such as the state of the economy within the organization and organization-wide competence needs also affect the outcome of an e-training initiative along with organizational culture and

structures (Newton et al., 2002). In this section these factors will be discussed in relation to the design principles for e-training.

The ability to transfer knowledge and attitudes gained from e-training to practice is essential for e-training to be effective (Amrou et al., 2015). If an employee cannot use what he or she has learned during the time spent on e-training, then the time and effort is of little or no use to the employee and organization. The metacognitive scaffolds in the e-training through web lectures assists this transfer of e-training. For metacognitive scaffolds to be effective, it is important that the employees are in control of their learning process and are allowed time for the process of learning and reflection (Paulsson et al., 2005; Lohman, 2006). When e-training is scheduled or structured on a timeline basis with deadlines for certain tasks, it presents a problem since employees often haven limited time and opportunities to interact with each other (Cho and Rathbun, 2013).

The extent to which an organization nurtures a sharing and collaborative environment also affects the learning, since employees learn through daily work activities while engaging with colleagues (Billet, 2014) and since the e-training through web lectures framework encourages the sharing of gained knowledge to promote articulation and reflection. A lack of proximity to colleagues' work areas will inhibit informal learning activities (Lohman, 2006), and thus having colleagues nearby will also affect the collaborative element of e-training. In this thesis the empirical data and other interactions the researcher had with the organization indicate that there is a collaborative environment in place. Some tasks like issuing a driver's license cannot be done without employees from different departments collaborating with each other. This means that there is a preexisting structure for

inter-professional communication and collaboration within the Swedish country administration that can be utilized when designing e-training.

Grossman and Salas (2011) identify four individual characteristics that have a strong influence on the training outcome: cognitive ability, self-efficacy, motivation, and perceived utility of training. Perceived utility ties in with the authenticity principle, which states that a high degree of authentic context and tasks will facilitate how the employees recognize the usefulness. If certain e-training is seen as important and made mandatory by the organization, it will have a negative effect if these values and the perceived utility are not shared by the employees (Newton et al., 2002). Self-efficacy and cognitive ability relate to the metacognitive and authenticity principle, since a belief in your own ability and your actual cognitive ability will affect the ability to reflect on how new knowledge can be transferred to practice and the ability to judge when the knowledge has been internalized. Motivation also affects e-training outcomes. Traits of motivation are perceived utility and possessing cognitive resources and energy for learning, as already mentioned above, but also to what extent employees feel confident at work, e.g. not being afraid of speaking up (Noe et al., 2010).

10.4 Design Science Research Methodology

There is a built in duality in e-training activities since they have the goal of both meeting the learners'/employees' needs and meeting the organization's/management's overall interest of competence development and success. Despite an increase of e-training initiatives in the workplace, most e-training applications still fail to satisfy learners' and organizations' needs. Furthermore, the e-training environment needs to be situated in the sense that the

learning should be relevant to the work practice and cannot be separated from the context where the new knowledge gained should be applied. This also implies that the design process of developing e-training also needs to be interwoven with the organization and the work practice (Sein et al., 2011; Baskerville et al., 2009). Therefore, it is sensible that e-training research should take a design-oriented research approach. Design science research (Gregor and Jones, 2007; Hevner et al., 2004) or action research inspired design science research (Sein et al., 2011; Baskerville et al., 2009) not only research how things currently are, but also design and realize how things could preferably be.

10.4.1 BIE and Proof of concept

Although not available at the time of designing the research process, the research process of this thesis resembles that of action design research (Sein et al., 2011), in that the context affected the WLA during development and use and thereby affected the emergent design principles. The evaluation activities in the design science research cycles influenced and informed the design in the following design science research cycle as described by Ihlström et al. (2011).

Mapping the research process of this thesis against the frameworks of Sein et al. (2011) starts with the first stage of problem formulation. The problem formulation stage (Sein et al., 2011) of this thesis was initiated by a literature review of prior research. The framework of authentic e-learning (Herrington et al., 2010) that came out of that literature review is a type 5 theory (Gregor, 2006), and a theory used to guide design. This type of theory is likely to inform and guide the design of the artifact (Sein et al., 2011). The initial artifact created was the concept for the web lecture application (see chapter six). This concept formed the basis for building the

web lecture application that was used in design cycles of intervention, evaluation, and further redesign. The web lecture application with the built in framework of authentic e-learning (Herrington et al., 2010) was then tested and evaluated with users from the target organization that was the county administration.

The artifact and the framework for e-training through web lectures then emerged through iterative design cycles (Vaishnavi and Kuechler, 2008). Following the framework of Sein et al. (2011), the iterative design cycles were classified as IT-dominant cycles of building, intervention and evaluation, since the WLA with its built-in framework of authentic e-learning (Herrington et al., 2010) emerged into a new version that was instantiated and evaluated again. These iterative design cycles resulted in a more mature artifact and evolved design principles. Sein et al. (2011) recommend a more seamless and constant evaluation and reflection because the largest part of the evaluation in this project was carried out in the evaluation phase of the process steps suggested by Vaishnavi and Kuechler (2008). However, as exemplified by the workshop with the representatives from the county administration that led to the circumscription in the development phase in the first research cycle, evaluation and reflection did take place during other phases of the design science research cycles.

10.5 Authentic E-learning in a Workplace Context

Herrington et al. (2010) intended their framework to guide the design of effective and immersive learning environments for technology mediated courses in a school context (see e.g. Smith and Parker, 2012; Narayan and Lovegrove, 2012; Wilson

and Schwier, 2012). Although it can be argued that higher education and workplace learning have a lot in common (Hodkinson, 2005), looking at the implications for design when authentic e-learning is mediated by technology in a workplace training setting, the research presented in this thesis shows how some elements of authentic e-learning (Herrington et al., 2010) are confirmed as still being valid for e-training while other elements of authentic e-learning (Herrington et al., 2010) need to be adapted to fit the conditions of e-training. Testing authentic e-learning (Herrington et al., 2010) in workplace contexts with other learning objectives than those addressing the class of problems described above, might arrive at another conclusion.

10.5.1 Evaluating e-training using a design science research approach

There is a need to develop better principles for what a good qualitative evaluation is in IS in general (Goldkuhl and Lagsten, 2012) and in design science research in particular (Venable et al., 2014). Evaluation is essential to find out if the developed artifact is useful for solving the problem that initialized the design process, and evaluation is a key activity in design science research (Hevner et al., 2004; Vaishnavi and Kuechler, 2008; Gregor and Hevner, 2013). Solving a problem in a relevant context is what Hevner et al. (2004) refer to as the relevance cycle, but evaluation should also consider the rigor cycle (Hevner et al., 2004) and contribute to the knowledge base. This means that design science research evaluation needs to be relevant, rigorous and scientific (Venable et al., 2012, 2014). There are examples of frameworks for carrying out design science research that include methods for evaluation (Peppers et al., 2007). Peppers et al. (2007) suggest that design science research could be evaluated through satisfaction surveys and mapping the artifact's functionality with the solution objectives defined at the start of the project. Other examples of literature discussing different design science research methods are

Nunamaker et al. (1991), March and Smith (1995), and Hevner et al. (2004), and there are a few articles that provide extensive guidance focusing on the evaluation phase (Venable et al., 2014; Mettler et al., 2014). Venable et al. (2012, 2014) provide a framework for how to choose an evaluation method in design science research that guides the questions of what, why, when and how to evaluate. The framework by Mettler et al. (2014) is restricted to evaluation of experiments using the principles of control groups, randomized assignment of the subject in the groups and evaluating the artifact under differing conditions.

A soft systems methodology approach to design science research (Sein et al., 2011; Baskerville et al., 2009) implies a naturalistic evaluation that disqualifies the positivistic view that Mettler et al. (2014) adhere to. Depending on the type of project and the goal of the evaluation, different evaluation strategies and methods are suggested. The strategies differ depending on whether the evaluation should be *ex ante*, i.e. formative before the instantiation of the artifact, or *ex post*, i.e. summative after the instantiation of the artifact (Venable et al., 2012). When choosing a method, it should be considered whether the evaluation should be naturalistic, i.e. real users using a real implemented system solving real tasks, or artificial, i.e. one or more of either real users, real systems or real tasks are missing from what is being evaluated (Venable et al., 2012, 2014).

Based on the framework from Venable et al. (2012, 2014) and the case of this thesis, an evaluation of design science research for e-training should be both *ex ante* (formative) and *ex post* (summative). The evaluation strategy should be naturalistic given the situated nature of learning in general and e-training in particular. There are also multiple stakeholders involved (organization/management and employees) and the e-training system is to be seen as a socio-technical artifact. The naturalistic

formative ex ante evaluation will then be with real users addressing a real problem but with a somewhat unreal system e.g. a prototype. The real users are not the end users of the final and implemented system, i.e. the employee, but rather the management/organization. Involving management early in the design process helps strategically align the e-training initiative against organizational goals and promotes a faster and more informed implementation of the e-training system (Newton et al., 2002). The naturalistic summative ex post evaluation then serves the purpose of engaging with real users using a real system on a real task, i.e. the employee after taking part in and finishing the e-training activity.

The evaluation method for the naturalistic formative ex ante evaluation could then be a focus group or as in my case a workshop with representatives from the organization manifesting the overarching goals with the e-training initiative. The method for the summative ex post evaluation could be, for example, a single method or a combination of the methods of participant observation and survey. It should be noted that in an e-training environment, observation is almost never an option due to the anytime/anyplace character of e-training. Interviews and surveys will tell you how the employees think they used the system, but as this thesis shows, analyzing web logs will indicate how they really used the system. Using web logs as a method for a naturalistic ex post evaluation is not mentioned in the research evaluation method selection framework (Venable et al., 2012). Adding the use of web logs as a method would add to the framework of Venable et al. (2012, 2014) as a method for evaluating real use in a context where traditional methods like participant observation is difficult to execute.

10.6 Validity of the design principles for e-training

There is a disagreement among practitioners on how to judge the quality of the outcome of design science research activities (Venable, 2010). In the pursuit of a qualitative outcome, this thesis has adhered to established literature on knowledge contributions in design science research (Venable, 2006; Gregor and Jones, 2007; Gregor and Hevner, 2013). The main contribution of this thesis are design principles for e-training through web lectures. These design principles add to the prescriptive knowledge on e-training and are a level two design science research contribution according to the knowledge contribution framework by Gregor and Hevner (2013).

Since design-oriented IS research is aimed at utility for practice (Winter, 2008), the outcome of design science research projects should be useful in solving or improving a real-world problem. This utility can be expressed by design principles and their efficacy, effectiveness, and/or efficiency in addressing the problem and technological solutions for that class of problems (Venable, 2006). The utility claim (Venable, 2006) of this thesis thus translates into the following statement: If principles for e-training through web lectures are followed when designing a system for formal work integrated learning, they will have a positive effect on the learning experience and learning outcome for the employees and thus increase the competence level of the organization.

One way to measure the efficacy of a framework is to measure to what extent a designer can implement the design principles of the framework when designing an artifact (Chandra et al., 2015). The design principles were validated through a weak market test (Kasanen et al., 1993) in that they were applied to the e-training systems of how to search the WWW and introduction to the new IT-milieu. Kasanen et al.

(1993) further note that even the weak market test is relatively rigorous thereby helping verify that the system is applicable to a class of problems.

Another way of validating the design principles for e-training and giving merit to the knowledge claim is to assess the design science research process. Although not a design theory, the design principles developed and presented in this thesis are consistent with the requirements for a design theory as defined by Gregor and Jones (2007). Gregor and Jones (2007) specify six core components of a design theory. It can therefore be argued that it makes sense to map the components of the design principles put forward in this thesis against the eight components of a design theory suggested by Gregor and Jones (2007).

Component		Corresponding chapter
(1)	Purpose and scope	Chapter 1-9
(2)	Constructs	Chapter 1-2, 4
(3)	Principles of form and function	Chapter 9
(4)	Artifact mutability	Chapter 5-9
(5)	Testable propositions	Chapter 5-9
(6)	Justificatory knowledge	Chapter 2 and 4

Table 28. Six core components of my design principles adapted from Gregor and Jones (2007).

The purpose of the design principles is to support the process of learning in a work related context. The transparency of how these design principles have transformed from the original theory of authentic e-learning to e-training through web lectures is described throughout this thesis. The scope of the design principles is accounted for in the class of problem section above. The constructs are found in chapters one, two and four where concepts such as e-learning, e-training, design, and knowledge contribution are described and discussed.

The principles of form and function start this last chapter and are framed by the concepts of authenticity and scaffolding. The forms of the principles are described and the functions of each principle explained on a general level. An indication of this is demonstrated in chapter eight, although the WLA was based on an early finding from the second cycle. Through the four design research cycles the utility claim above has been evaluated in an authentic environment.

Justificatory knowledge consisted of theories informing the pedagogical design, the design of the learning material and the design of the graphical user interface. The methods were also rooted in a theory (Walls et al., 1992), and the interviews were guided by the four-step method of inquiry (McCracken, 1988). Justificatory knowledge as defined by Gregor and Jones (2007) can also include experience from practitioners, or in the case of this thesis, previous experience and knowledge from teaching in the topic of the WLA (how to search the WWW).

Aside from the instantiations in this thesis, more instantiations of the design principles for e-training through web lectures are necessary to test if they will lead to lasting improvements for integrating authentic and relevant learning that translates into work practice in a manner that adapts to everyday work.

10.7 Current trends in research on e-training

The problem domain of workplace e-training is in the intersection of work, learning and IT. The goal of workplace e-training is the acquisition of new knowledge and the development of skills supported by IT that result in improved work performance of the employees. Learning is in this thesis seen as situated and adheres to a socio-

cultural view of learning. This means that learning and knowledge is a product of the activity, context and culture in which it is created and used (Vygotsky, 1978; Säljö, 2001). If the activity is supported by IT and leaves digital footprints, then the possibility to analyze the use patterns and learning behaviors arises. If the technology supporting the learning activity is mobile, then it will potentially increase the authenticity and enable a higher degree of personalized learning. These are the themes for the account of the current trends in e-training and how it relates to the framework of e-training through web lectures.

Web usage mining is the use of data mining techniques on web log data to discover usage patterns (Cooley et al., 1997). One of the current trends is to measure learning and good learning behavior through web usage mining and data mining techniques in e-learning (Johnson et al., 2014), sometimes referred to as educational mining (Naqvi, 2015). The vast majority of educational mining studies are done in a school environment, but can in a similar way be helpful in an IT supported workplace learning environment. If IT is to support workplace learning, it needs to consider the conditions of work.

In current research about web mining, educational contexts are to a large extent used to support the learners or the teachers. It could be to personalize the learner experience (Zaiane, 2002; Khribi et al., 2009) or to identify potential problems in the learning process so the teacher can take action (Ueno and Nagaoka, 2002), but web mining is rarely used to guide the overall design of the learning environment. Educational mining has great potential in supporting the learner (Zaiane, 2002; Khribi et al., 2009) and/or the teacher (Ueno and Nagaoka, 2002), but it can be argued on the basis of this thesis that there is great potential to support the design process of the learning environment as well, not only site efficiency (Zorilla et al.,

2005). This thesis used educational mining to crystalize and reinforce design guidelines. Educational mining reveals actual use of an e-learning system in a way that is very hard, if not impossible, to do through other ways of gathering empirical data. In the workplace, observation is almost never an option due the anytime/anyplace character of e-training. Interviews and surveys will tell you how the learners think they used the system, whereas educational mining shows how they actually used the system.

With today's widespread distribution of mobile technology with wireless access to the Internet, mobile technology has the potential to positively impact authentic e-training by bringing the e-training situation to the relevant context. This does not decrease the importance of authenticity in e-training, since any discrepancies between the real world and the learning material will be as disruptive or more if the learner is in the actual context of learning. There is a dawning discussion about the challenges and problems that arise when employees work in virtual organizations without the organizational boundaries (Zhang, 2016). Virtual work can be working from home or on the road independent of time and place (Chudoba et al., 2005), however, in this study most of the learning was unplanned at the work place during work hours. With the increase of ever-connected mobile phones and working outside a traditional office, we might also see an increase of unplanned learning away from the workplace.

Access to relevant learning material almost anywhere/anytime also coincides with the fact that work is to a greater extent mobile. Employees are more mobile today and are working outside the office more than ever. My study showed that the employees preferred to share what they learned with friends, family and peers than with others participating in the same learning activity. Informal learning and the

sharing of knowledge with friends and peers could increase even more with the use of mobile technology. Mobile technology is also significant in enabling personal learning networks, where the learner uses people from their personal network for informal learning and to gain knowledge (Santos et al., 2014).

Within the technologies that support e-training there has also been a development in medium from text-based to multimedia, which makes it possible to make learning more effective by personalizing the content. If learning material and tasks are developed to be authentic and adapted to organizational and personal needs, then the learning material could be described on a meta-level using e.g. XML. Learning material can be divided into smaller learning packages or learning objects and then re-assembled to fit the exact need of the individual learner (Biletskiy et al., 2009). A clear structure of the learning material and the different concepts provide the employee with conceptual scaffolding as shown in this thesis. A personalized path through the learning environment with activities customized towards the individual learner's learning goals provide an even stronger conceptual scaffold. It enables automatic suggestions of other relevant resources based on the personalization information from the learning environment. This strengthens the procedural scaffolding provided by the learning environment and gives the employee greater opportunity to investigate the topic from multiple perspectives.

One well established trait of e- training is the benefits of being able to access the learning environment and the learning material in a more flexible way, decreasing the limits of time and space. This gives learners the opportunity to be in control of their learning process, which is essential when learning at work. The workplace conditions affect the success of workplace learning and this stresses the importance of IT being able to adapt to the conditions of work.

With this access to the Internet anywhere/anytime, another trend is that learners seek knowledge and learn on their own (Johnson et al., 2014). The challenge herein is how this informal, spontaneous learning can be combined with formal more institutionalized learning and training (Johnson et al., 2014). When designing future learning, it is important to consider that learning will intersect not only institutionalized formal training and informal spontaneous learning, but also intersect life spheres such as work and private and public life (Punie, 2007).

10.8 Conclusion

This thesis has adopted a design science research approach (Vaishnavi and Kuechler, 2008; Gregor and Jones, 2007; Gregor and Hevner, 2013) that in retrospect resembles the action design research approach (Sein et al., 2011). The kernel theory of authentic e-learning (Herrington et al., 2010) has through stepwise refinement of concepts and instantiations and through four design research cycles culminated in design principles for e-training through web lectures and adds to prescriptive knowledge on e-training, a level two design science research contribution (Gregor and Hevner, 2013). Design science research puts a greater focus on the design research process, allowing for the design principles to emerge from the kernel theory of authentic e-learning and the conditions of work through iterative design science research cycles. The design principles for e-training aims at supporting autonomous employees who need to integrate authentic and relevant learning that translates into attitudes and increased skills/competence in a manner that adapts to their everyday work.

10.8.1 Limitations

The research presented in this thesis address a class of problems related to self-regulated e-training through web lectures'. An obvious weakness in the research design is the fact that data has been collected from organizations within one specific sector of public service (i.e. the Swedish county administrations). However, I argue that this is to some extent is balanced by the fact that the conclusions are based on four consecutive cycles of design science research.

Concerning details in collecting and analyzing data, it can be noted that the questionnaire would have benefited from having a larger sample size, especially if my study were to generalize on the result from the questionnaire alone. However, the study also included empirical data from interviews and web logs which, together with the theoretical underpinnings, makes the research contributions of the PhD-project applicable. Further validation of the design principles is also necessary to test if the application of the design principles will lead to improvements in other contexts and thereby be proven applicable to the class of problems the design principles aim to support. It should be noted that the employees, i.e. the learners, in this study were motivated to participate in the e-training activities. The employees who participated in the e-training activity on how to search the web volunteered to participate, and the topic itself came as a suggestion from them. In the case of the IT-milieu it could be argued that the participants' attitudes might not necessarily be as positive, but the employees were still motivated to engage in the e-training in order to know how to carry out their everyday work after the new IT-milieu was implemented. Even with a top down compulsory e-training activity with no clear benefits for the employees, there could still be organizational or managerial

motivations behind it, and this would likely bring forward other attitudes among the employees.

10.8.2 Research Contribution and Implications for Practice

This thesis forwards the design science research methodology through a demonstration of its applicability in confirming, exapting and developing emerging design principles for workplace e-training. In retrospect, the four cycles of design research reported in this thesis rendered valuable insights regarding the particular conditions that frame the challenge of designing for work-integrated learning. Additionally, the research put further light on the complexity of designing for e-training. The intricate task of combining instructional design informed by learning sciences with technological design informed by the knowledge domain of IS research was a constantly ongoing challenge for me as a researcher. In the concluding design principles for e-training through web lecture applications, I aim to present a sound resolution to this epistemological conflict, and my journey as a PhD student has humbled me with respect to how these issues and profound questions will be challenged by emergent technological innovations and alterations in the global infrastructures of the working life of tomorrow.

New technologies, emerging through the development of recent years, implicitly articulate questions that need to be addressed in further research: How can mobile technology extend the support of e-training. How can social media impact the design space of e-training? How can micro-blogging and social bookmarking be utilized in e-training? What are the consequences for organizational training imposed by phenomena such as massive online open education initiatives, and how can open educational resources alter the e- training landscape of tomorrow?

Furthermore, it would be interesting to see how IT support for workspace awareness (Nilsson and Svensson, 2012; Gutwin & Greenberg, 2002) affects the sharing of knowledge from e-training activities. Will an established environment with ICT support for workspace awareness increase the sharing of knowledge and thereby the general level of competence? All in all, the research reported in this thesis constitutes a foundation for our understanding of the conditions that frame the design for workplace e-training. Through the emerging Design Concept of web lectures, I have gained profound insights into the complexity of designing for work-integrated learning. By embracing the duality of combining pedagogical and technological design challenges in an authentic and scaffolding workplace context, I have concluded design principles for work-integrated e-training through web lectures. In further research, the transferability and the reach of the proposed design principles will be challenged and tested by me, my peers and other scholars interested in the relation between information technology and work-integrated learning.

11 References

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12 Appendices

Questionnaire:

1. Gender:

- ☐ Female
- ☐ Male

2. Age:

- ☐ 18-25
- ☐ 26-35
- ☐ 36-45
- ☐ 46-55
- ☐ 56-65

3. I am currently working:

- ☐ Full-time
- ☐ Part-time

If part-time then enter percentage:

4. How much time do you spend at the computer on a daily basis (including time spent both at home and at work)?

Less than one hour, enter how many minutes:

More than one hour, enter how many hours:

5. How often do you search for information using a computer (using the Web, databases, intranet, etc.) compared to searching for information the traditional way (books, files, archives)?

- I usually search for information in a traditional manner

☐ I usually search for information using the computer combined with the traditional manner of searching.

☐ I usually search for information using the computer.



Comment:

6. How many times in total did you visit this website?
(<http://www.ostlund.stream.hv.se/Attsoka/>)

- ☐ Once
- ☐ Twice
- ☐ 3-4 times
- ☐ 5 or more times

7. Have you ever gone back to the web lecture and rewatched parts of it?

- ☐ No
- ☐ Once
- ☐ Twice
- ☐ 3 times
- ☐ 4 or more times



Comment:

8. Did you follow any of the links under “Read more”?

- ☐ No
- ☐ Followed one or two links
- ☐ Followed three or four links
- ☐ Followed five links or more

Comment: 

9. If you followed any of the links under “Read more”, did you find them interesting and was the information valuable?

- ☐ I did not follow any of the links
- ☐ No, I did not find them interesting
- ☐ Only read a little
- ☐ Quite interesting
- ☐ Very interesting

Comment: 

10. Were you able to carry out your study sessions on time and in a manner that was suitable for you?

- ☐ Yes
- ☐ No
- ☐ Sometimes

11. Did you take any breaks during the web lecture?

- ☐ Yes
- ☐ No

If yes then how many minutes approx.?

12. Did you do any of the exercises?

- ☐ No
- ☐ One of the exercises
- ☐ Two or three of the exercises
- ☐ All of the exercises

13. If you completed the exercises, did you do it following the video that preceded the exercise?

- ☐ Yes
- ☐ No
- ☐ Sometimes
- ☐ Did not complete the exercises

14. Did you contact the teacher of the web lecture at any point?

- ☐ Yes
- ☐ No, it wasn't necessary
- ☐ No, didn't know it was possible
- ☐ Other:



15. Did others participate in the web lecture during the same time as you?

- ☐ Yes
- ☐ No
- ☐ Don't know

16. How important is it for you to collaborate/discuss the web lecture such as "Searching the Web" with other participants?

- ☐ Not important
- ☐ Doesn't matter
- ☐ Important
- ☐ Very important

17. How much would you like to be able influence the schedule for web lectures?

- ☐ Not at all, it is easier to follow a given schedule
- ☐ To a small degree
- ☐ To a high degree
- ☐ I want total freedom over when I take part of in the course

Other: 

18. What did you think of the length/duration of the web lecture?

- ☐ Too short
- ☐ Short
- ☐ Just fine
- ☐ Long
- ☐ Too long

Comment: 

19. What did you think of the length of the individual videos?

- ☐ Too short
- ☐ Short
- ☐ Just fine
- ☐ Long
- ☐ Too long

Comment: 

20. How relevant was the content of the web lectures?


- ☐ Very relevant (80-100% relevant content)
- ☐ Mostly relevant (60-80% relevant content)
- ☐ Quite relevant (30-60% relevant content)

- Less relevant (0-30% relevant content)

Comment: 

21. Did the web lecture meet your expectations?

- Better than expected
- As expected
- Worse than expected
- I had expected something completely different

Comment: 

22. Are you satisfied with the web lecture as a whole?

- Very dissatisfied
- Dissatisfied
- Fairly dissatisfied
- Satisfied
- Fairly satisfied
- Very satisfied

Comment: 

23. Did you take notes while you were watching the web lecture?

- Yes
- No

24. Did you learn something new?

- A lot
- Quite a lot
- Some
- A little
- Nothing at all

Comment: 

25. Would you like to take another similar web lecture on a topic of your choice?

- Yes
- No
- Don't know

Comment: 

26. Have you changed the way you search for information after finishing the web lecture?

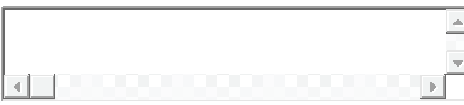
- To a very large extent

- ☐ To a large extent
- ☐ To some extent
- ☐ To a little extent
- ☐ No change

Comment: 

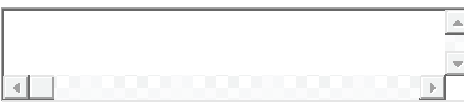
27. Do you feel that you have become better at searching the WWW after finishing the web lecture?

- ☐ Yes
- ☐ No

Comment: 

28. Would you prefer a text-based version with pictures and the possibility to print the web lecture?

- ☐ Yes
- ☐ No

Comment: 

29. Do you have any general comments?

-

2nd questionnaire changes


For the second questionnaire, the following questions were replaced:

3. How much have you used Google or any other similar search engines before taking part in the web lecture?

- ☐ Several times a day
- ☐ Couple of times a day
- ☐ Couple of times a week
- ☐ Couple of times a month
- ☐ Very seldom
- ☐ Never

15. Did you discuss the content of the web lecture with any of your colleagues?

- ☐ Yes
- ☐ No

Comment: 

For the second questionnaire these questions were changed:

4. How often do you usually use a computer in a day?

Number of hours at work:

Numbers of hours outside of work:

11. How did you take part in the web lecture?

- ☐ All at once, without breaks
- ☐ With 1 or 2 breaks during one day
- ☐ With 3 or 4 breaks during one day
- ☐ With 5 or more breaks during one day
- ☐ With 1 or 2 breaks during two or three days
- ☐ With 3 or 4 breaks during two or three days
- ☐ With 5 or more breaks during two or three days
- ☐ With a number of breaks during four days or more

Comment:

For the second questionnaire, these questions were added:

28. Based on what you have learned from the web lecture, have you taught or mentioned to anyone as to how they can become better at searching?

- ☐ Yes
- ☐ No

Comment: 

29. Did you take the assignment in order to get the certificate?

- ☐ Yes
- ☐ No, I do not need a certificate
- ☐ No, I thought the assignment was too time consuming

- No, I thought the assignment was too demanding
- No, I thought the assignment was too vague
- Other reason. Please describe:

Interview guide for searching WWW:

Intro

Hello!

My name is Christian Östlund and I'm calling about the evaluation of the course to search the Web. I will call you to schedule interviews. Either I will come to you or we will do it over the phone. I will record the interview if it is OK. I will be the only one who will listen to them and any conclusions that I draw from my interviews will be presented in summary form so that individual responses cannot be tracked. The whole thing will take about 20-30 minutes.

Background

- Describe your work tasks and what a typical day is like for you?
- What types of training have you previously participated in
 - Previously, e-learning experience
 - Traditional one / multi-day training
- Do you get to choose which courses you want to go or are you given suggestions
 - Is it worthwhile to develop the skills of the ??
- The pros and cons between the different types
 - What type of training suited to e-learning?
 - All, shorter training programs,
- What was it that made you sign up for the lecture?

To search the WWW

- Have you answered the questionnaire?
- How did you take part in the "Searching the Web"?
 - Approximately how many and how long breaks did you take?
 - What made you choose this approach
- Discussed your lecture with others
 - Did you talk about how the web lecture made you more skillful
 - How many? In what way
- Did you do the exercises?
 - Did the little extra, the exercises helped you to understand
 - Would it have been better with examples from Länsstyrelsemiljö although they may not have been directly from your business?
- Did you do the task?
 - How big is the need for a certificate
- Did you go back to the Web lecture?
 - Why
 - Will you go back in the future?
- Could you sit undisturbed and listen to the lecture?
 - Did you know you were busy
 - Did you want to be disturbed if there was something important they wanted
 - Was it easy to return to the lecture afterwards?
- Would you like to collaborate with others who also took part in the web lecture?

- Writing in the discussion forum
- Discuss the chat by talking
- Would you adapt to specific times?
- How would you work if you had to decide exactly?

Finishing questions

- How do you think that such training can be done better?
 - What do you think is the most important to invest in and develop when it comes to this type of training?
 - What conditions do you need to best learn with the help of the computer?
 - Prioritize if they give several suggestions

Interview guide for “migration of IT-milieu”:

In general

- Describe your job / what do you do?
- What types of training have you previously participated in
 - Previously, e-learning experience
 - Traditional one / multi-day training
- The pros and cons between the different types

IT-milieu

How did you take part in the course?

- How many times have you visited and viewed?
- For how long?
- What made you choose this approach
 - If you, or other factors governed?
- Discussed your lecture with others
- Did you do the exercises / tests?
 - Did the little extra, the exercises helped you to understand
- Did you go back to the Web lecture?
- Could you sit undisturbed and listen to the lecture?
- Be more understandable?
 - Was there any information you missed and had to ask your local IT people?
 - Was there any information you felt was unnecessary?
- Did you feel confident about the migration process after reading the information?

Finishing questions

- How do you think that such training can be done better?
 - Did you find that this web-based information is a good way to provide this kind of information?
 - If not! What would have been better?
 - What do you think is most important to invest in and develop when it comes to this type of training?

The Swedish original text of the invitation letter for the web lecture

Konsten att söka på Internet

Får du alldeles för många träffar när du söker information på Internet eller vågar du inte använda Internet för att söka information? Vet du inte hur man använder Google eller vill du bara bli ännu duktigare på att googla? Då kanske du vill testa en ny utbildning!!

Christian Östlund på Högskolan Väst har gjort en utbildning på ca 1 timme om hur man använder Google för att på ett effektivt sätt söka information på Internet. Via Länsstyrelseakademien kan ett antal anställda på Länsstyrelsen få möjlighet att prova denna nya interaktiva utbildning. Utbildningen sker via din dator på arbetsplatsen och du kan göra den i flera steg och i den takt du vill. Motprestationen är att du efteråt måste svara på en enkät (tar 10-15 minuter att fylla i). Christian kommer även att kontakta ett antal personer för kompletterande frågor.

Intresserad? Klicka på denna länk och anmäl dig till kursen på Länsstyrelseakademiens hemsida.

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